The AMSAT® Journal

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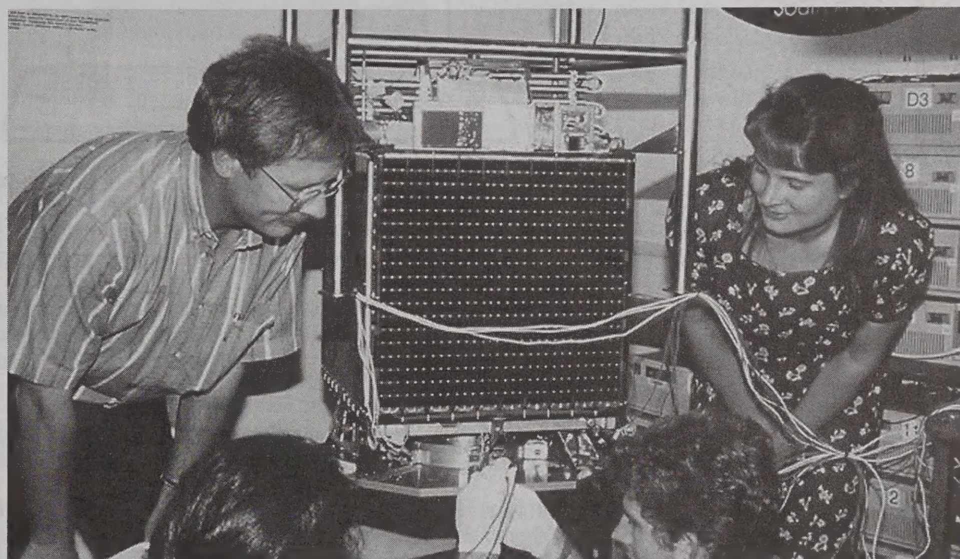

SUNSAT, a microsatellite built by the University of Stellenbosch, South Africa with SA AMSAT involvement is scheduled to be launched 17 December 1998 at 1230 UTC from Vandenburg AFB.

SUNSAT: South Africa's First Satellite

Hans Van De Groenendaal, ZS5AKV (*hans@intekom.co.za*)

SUNSAT, South Africa's first Amateur Radio and Scientific satellite is scheduled to be launched 17 December 1998 at 1230 UTC aboard a USAF Delta II launcher. The concept of SUNSAT was born nine years ago in December 1989 at a conference hosted by the Bureau for Systems Engineering at the University of Stellenbosch when a proposal to launch a mini-satellite program was accepted. The original name for the program was *Kleinsat* (*klein* being an Afrikaans word for small).

Professor Garth Milne, ZR1AFH became project leader, and after some eighteen months spent defining the project and seeking industry sponsors for the program, on 27 June 1991, an Advisory Board was established and the program officially launched under the banner SUNSAT. The name SUNSAT closely associates the program with the University (**S**tellenbosch **UN**iversity **SAT**ellite). SA-AMSAT has been represented on the Board

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Apogee View

Passing the Torch
by Bill Tynan, W3XO

In November 1991, the AMSAT Board asked me to assume the Presidency of the organization. At that time, we were just beginning our participation in the Phase 3D Project. Our technical people had taken part in early planning meetings to define that spacecraft and its performance, but we had not begun to fabricate hardware. We had however, begun to think about means of raising the funds needed to support our commitments to the Project, but very little money had yet been collected on our side of the pond. I saw it as my mandate from the Board, and the AMSAT-NA membership to put in place a fund-raising effort that would meet the requirements.

A situation that was hanging over the organization at the time I was asked to take over involved an agreement between us and a commercial organization called Interferometrics regarding the Microsat Project. Our agreement with that firm called for us to supply documentation on the Microsat design and for them to make payments to AMSAT for satellites they built and sold, using that design information. Under the agreement, a minimum payment was called for even if no satellites were sold in a specified time. That time had expired and no payments had been received. However Interferometrics contended that AMSAT had failed to adequately meet its commitments with respect to the data provided. As one of my priority tasks after being asked to assume Presidency, I vowed to make certain that we turned over all possible information to Interferometrics and to insure that payments due us, were received. As a result of this effort, some additional data was provided to Interferometrics and a sum of $42,000 was received from them to cover the use of AMSAT data in the construction of EYESAT, the spacecraft we hams know as AO-27. This sum went a long way toward compensating us for the expenses incurred in the Microsat Project.

Concurrently with negotiating with Intereferometrics, I set out to initiate the fund-raising effort needed to support the Phase 3D Project. This took the form of composing letters to our members asking them to support the Project. The first of these letters, which went out in early 1992, was written with the help of our former President, Doug Loughmiller (then KO5I, now W5DAL) before he left for England to take a position at the University of Surrey. The results obtained with this first letter exceeded my most optimistic expectations, bringing in over $100,000. We were off and running. Once the donations began rolling in, it was immediately apparent that keeping track of them would be a monumental and exacting task. My old friend, and longtime AMSAT member, Bob Carpenter, W3OTC stepped in and volunteered to do the job. Bob had already proven himself in this kind of task by modernizing the AMSAT membership records, including combining the foreign and domestic lists into a single readily accessible database. Bob has been managing the Phase 3D fund-raising database ever since and has been doing an excellent job. We have now raised over ONE MILLION DOLLARS from our members and the ARRL has added another sum of over a HALF MILLION DOLLARS. Although I take some measure of pride for my efforts in this fundraising accomplishment, I must say that without Bob's efforts in accurate record keeping and reporting, we would have not been able to gain the confidence of you, the contributors, that would induce you to contribute over and over again, year after year. I want to again extend my sincere thanks to all of you who contributed so generously to Phase 3D.

In addition to Bob's help in fund-raising I must acknowledge the assistance of many other people in the Phase 3D project and the management of AMSAT. One of the first that comes to mind is Martha Saragovitz. Without her work, efficiently running the office, handling membership and always being there to help with questions from members or prospective members, I would not have been able to carry my duties as President. Also, Keith Baker, KB1SF who has been serving as Executive Vice President for the past several years, has been my right hand in both Phase 3D and other AMSAT matters. In addition, AMSAT and I owe a deep debt of gratitude to the other officers, especially including; Frank Bauer, KA3HDO, VP for Manned Space Programs, Keith Pugh, W5IU, VP Operations, Art Feller, W4ART, our Treasurer, Barry

Baines, WD4ASW, VP for Field Ops, Perry Klein, W3PK, VP for Government Liaison, Paul Williamson, KB5MU, VP Electronic Publishing and Ray Soifer, W2RS, VP for International Affairs. Another key role in any technical project in which AMSAT is engaged, is that of Vice President for Engineering. This position has been particularly critical during our participation in the Phase 3D Project, and has been filled by three knowledgeable people during my tenure as President; Jan King, W3GEY, Dick Jansson, WD4FAB and most recently Stan Wood, WA4NFY.

Our efforts on behalf of Phase 3D could never have proceeded to their current state of completion without the long hours of exacting labor of the folks at the Phase 3D Integration Laboratory in Orlando; Lou McFadin, W5DID, Richard Leon, KA1RHL, and Bob Davis, KF4KSS. Also, the Project could not be where it is without the hard work of so many skilled volunteers, both in this country and abroad, too numerous to list them all.

In addition to our Phase 3D-related efforts, numerous volunteers have participated in many other facets associated with maintaining the organization. These include the members of the AMSAT Board of Directors, who have helped chart our future course. Our Vice President for Future Plans, Bill Burden, WB1BRE has also contributed to this process, by providing the Board with insight based on his considerable and varied experience.

One of the key roles is that of AMSAT Journal Editor. Russ Tillman, K5NRK has been serving in that capacity for several years and he and his crew have been doing the kind of job that allows me to not have to worry about this vital aspect of our operation. If that were not enough, Russ also volunteered to host this year's Annual Meeting and Space Symposium. He has put a fine group of volunteers together and their combined efforts remove another potential worry.

One of the projects on which we expect to embark in the months to come involves providing help to the University of Toronto on the MOST satellite project. One of our key players in this important effort is Robin Haighton, VE3FRH. Robin shows great potential in both engineering and management areas.

The unsung heroes of AMSAT are the Area Coordinators, who are our front-line representatives at conventions and hamfests, as well as in face to face meetings with hams new to satellite operation. We all owe a great deal to them. The work of Walt Rader, WA3DMF as AMSAT QSL Manager must also be acknowledged with thanks.

I am sure I have missed mentioning people who make significant contributions to AMSAT and the amateur space community. There are simply too many of them to cite them all. For that omission, I apologize and thank them very much for their dedicated hard work and service.

When I took over as President, I hoped that I would see Phase 3D safely in orbit before I left the Office. I have maintained that hope, and worked toward that goal since that time. But, as you all know, we have suffered a setback with regard to a launch for that spacecraft. The satellite is essentially complete and is to undergo thermal vacuum testing in October. It will be ready for a launch whenever that can come to pass. Therefore, I feel, that after seven years, now is a good time for me to step aside as the President of our organization. The selection of my successor is, of course, up to the members of the Board, whom you have elected to represent you. I have only one vote on that seven-member board. However, recognizing his service and great knowledge of the running of the organization that he has acquired as Executive Vice President, I intend to recommend to the rest of the board members that Keith Baker, KB1SF, be selected as our next President. The selection of the other officers required by the By laws; Executive Vice President, Vice President for Engineering, Vice President for Operations, Secretary and Treasurer are up to the Board to select. The other offices can be created and filled at the discretion of the President.

So, again thanks to all who have helped and supported me during these past seven years. Although there have been times when it had its frustrations, I have very much enjoyed serving as President of The Radio Amateur Satellite Corporation. It has, in fact, been one of the high spots of my life, that I know I will look back on in the years to come. My term on the Board runs for another year, and I will continue to serve AMSAT in that capacity. I will also continue to help the organization in whatever ways I can and, of course maintain my interest in amateur space activities in general. ■

[SUNSAT continued from page 1] since its inception together with three major industries: Alcatel Altech Telecoms, Siemens and Plessey SA, and the Foundation for Research and Development.

University of Stellenbosch

The University of Stellenbosch is situated in Stellenbosch, the second oldest town in South Africa, not far from the southern tip of the African continent and some 50 km east of Cape Town. The University has over 14,000 students and is the oldest University in the country with an excellent academic record.

SUNSAT has been built by students who performed detailed design and software development tasks. The system level design was carried out by lecturers, some of whom have studied at the Universities of Surrey, Stanford and MIT. Therefore, it is not strange that there is a strong resemblance between SUNSAT and satellites built by the University of Surrey. South Africa has an innovative electronics industry that wishes to benefit from new opportunities. It also needs competent, technically trained people to establish and operate systems. The SUNSAT program is a means of increasing space segment knowledge, establishing a satellite training capability, and exposing industries' capabilities for South Africa. As a result, the SUNSAT program has delivered over 50 students with Master of Engineering Degrees.

Payloads

SUNSAT has several payloads with two focusing on Amateur Radio and School Science projects. In addition, SUNSAT will carry and conduct NASA experiments and an experimental pushbroom imager.

Amateur Radio Payload

The basic Amateur Radio payload will include the following:

- Two meter FM parrot repeater operating on 145.825 MHz using NBFM voice with 3 kHz peak deviation
- 1200 Baud packet radio capability FSK store and forward
- 9600 Baud (G3RUH) packet capability AFSK store and forward

During the selection of the Amateur Radio payload, particular attention was given to meeting the following criteria:

- To supplement the SAREX and the Dove programs in bringing Amateur Radio into the classroom. SAREX has been particularly successful in getting the attention of the younger generation. However, due to the many constraints imposed by scientific missions, Shuttle and *Mir* access to the SAREX program has become very limited.
- To provide the general Radio Amateur community with easy access to satellite communication and serve as a primer for more serious satellite work.

Currently, SUNSAT's operating schedule is not final and depends on a complex time-varying power budget and software timing. The operating schedule will be completed soon after launch and will be communicated via the various AMSAT channels and also be available on the SUNSAT web site at *http://sunsat.ee.sun.ac.za*

School Projects

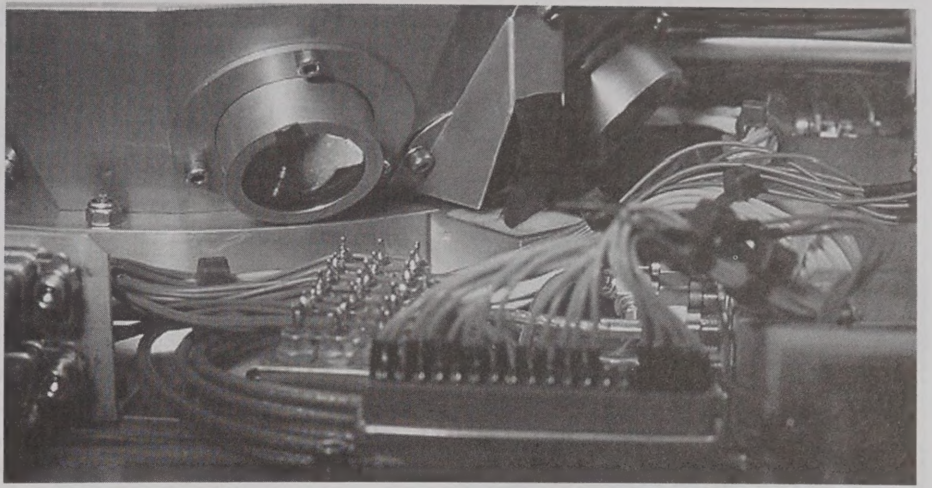
Two projects were built by school groups:

- George Campbell Technical High School (Durban) developed and built a microphone experiment that will monitor sounds generated by vibration, the reaction wheels, and boom deployment.
- Rhenish Girls High School in Stellenbosch developed an experiment that will monitor the effect of radiation on small electronic components.

Scientific Payloads

A high resolution imager providing 50x50 km coverage will operate in real time on the Mode S band. These images can also be stored in the RAM disk and portions can be downloaded at 9600 baud by Radio Amateurs.

The S band downlink operating at 5 Watt EIRP will produce a 14.4 dB S/N ratio in a 40 MHz bandwidth at a 2000 km slant range for a 4.5 m diameter 100k receiving station planned for Stellenbosch. By adding an L band receiver and appropriate switching, a transponder capable of 1 Mb/s with a 2m diameter ground station can be implemented. Application of the system for Amateur Radio gateway access is thus possible.



Corner cubes reflect laser beams directly back to the laser irrespective of arrival angle , enabling *cat's eye*-type reflections to be obtained from the satellite. NASA laser ranging stations can determine the range to millimetre accuracy.

Frequencies and Power Output

Downlinks:

- 145.825 MHz
- 436.300 MHz
- 436.250 MHz

These frequencies are generated under crystal control but if required frequencies near the above can be synthesised in 12.5 kHz steps

Power output:

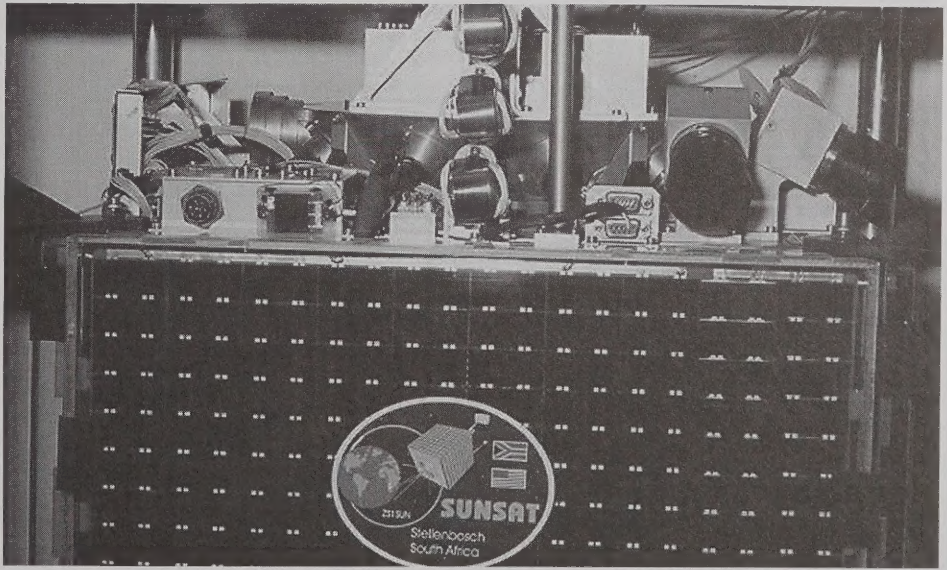
- VHF: 1W or 4W
- UHF: 1.5W or 10W

The power quoted is PA power, some cable losses will occur. The antennas are RHCP with a broad beamwidth. The satellite will operate primarily on the lower power setting except while over Africa. Amateur Radio operators and school groups in other parts of the world can e-mail a request for high power operation for specific experiments or events. However, high power operation will be limited by power availability.

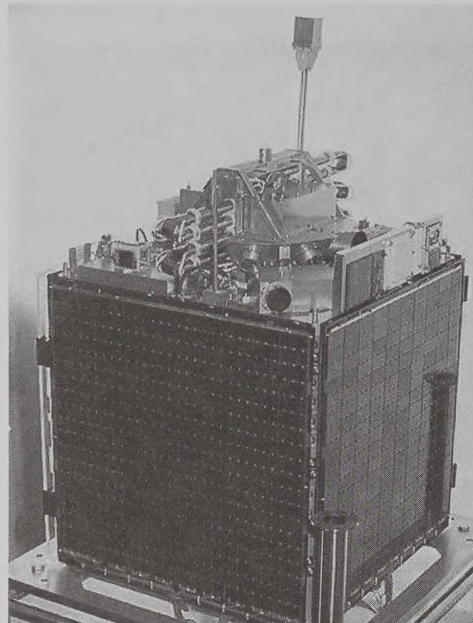
Uplinks:

- 145.825 MHz
- 145.850 MHz
- 145.900 MHz
- 145.950 MHz
- 436.300 MHz
- 436.250 MHz

Frequencies are generated under crystal control but other frequencies near the above can be synthesised in 12.5 kHz steps.



Horizon sensors inclined 30 degrees downwards are visible on the front right corner. Spanning 30 degrees field of view, the 2048 element linear CCD sensors measure the satellite's orientation relative to the earth in their two planes with a resolution of better than one arc-minute.



Complete SUNSAT on lower of handling frame.

Orbit

Launched by Boeing for NASA, SUNSAT will be placed into a polar orbit of 550 by 850 km. The equatorial crossing will initially be at 13:00 UTC and drift one hour earlier every 70 days. SUNSAT will carry a precision GPS receiver and a set of laser retro-reflectors. These will enable NASA to study fine orbital perturbations for gravity field recovery and cross verification of GPS and NASA's laser tracking network. SUNSAT will be on the same launcher as the Oersted satellite.

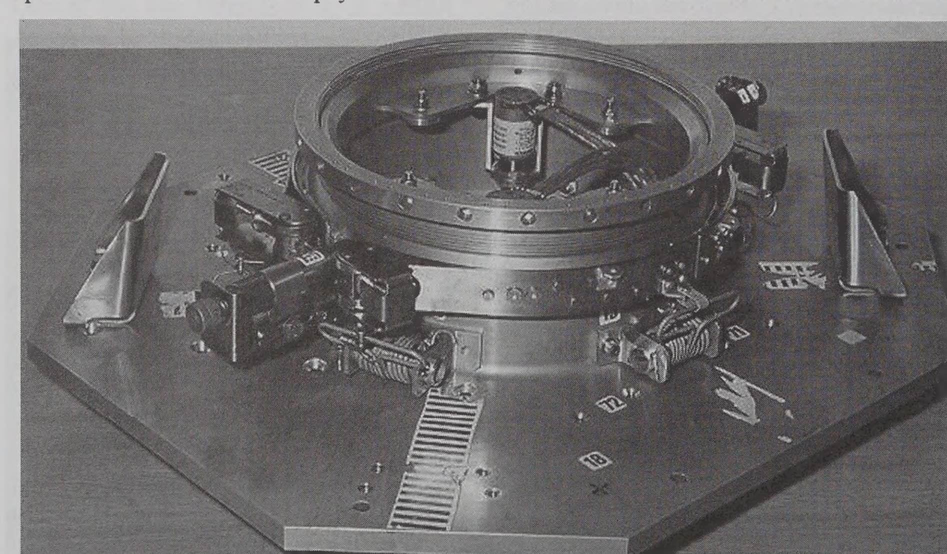
Power Budget

Operation of the various payloads will depend much on the power budget. The DC power budget is complex because the solar input varies as the orbit drifts from its starting point at 15:00 local time. It becomes an hour earlier every 70 days. At the 12:00 orbit, power generation will be low as the side-mounted solar panels receive no illumination at zenith.

Launch

The launch is currently scheduled for 17 December 1998 at 1230 UTC from Vandenberg Air Force Base, California. The launch will be towards the south bringing the rocket over the South Pole. Minutes later, the Space Applications Center of the CSIR in South Africa will receive telemetry from the launcher as it releases the US Air Force ARGOS satellite over Madagascar and progresses towards the North Pole.

Another 50 minutes later the rocket will be over California again and SUNSAT will be released. The ground station at Vandenberg, California will uplink commands to SUNSAT, and the first signals will be received from SUNSAT for approximately 30 seconds before the satellite goes below the horizon. Fifty minutes later, coming from the south, SUNSAT will come into range of South Africa and cross almost directly over the country. SUNSAT's signals should be audible on the Amateur Bands. Over the next few days Stellenbosch will detumble the satellite and deploy the boom. The satellite will stabilise its attitude and the first images are expected to be taken about two weeks after launch. SA-AMSAT will set up a launch net and will relay the various launch activities on HF as well as via the Sentech 500 kW transmitters.



SUNSAT's Payload Adaptor Assembly (PAA) is a threaded cylinder screwing into the bottom of the satellite. The clamp-band presses V-blocks against angled flanges on the mating surfaces of the PAA and PAF during launch. Explosive cutters release the clamp-band to free the satellite. A seperation switch and the PAA locking ring are seen on the PAA. Stainless steel bumpers (left and right) protect satellite antennas from being struck by the clamp-band.

Attitude Determination and Control Systems

The attitude determination and control specifications on SUNSAT are stringent for a micro-satellite. The design goal is to be able to point the pushbroom imager boresight to within one kilometer accuracy from an 850 km altitude.

Five types of sensors have been built into SUNSAT. A three-axis magnetometer is used to measure the strength and direction of the geomagnetic field. This low-power 100 mW device can be operated continuously to provide attitude accuracy approaching one degree. Course attitude information is also derived to within five degrees from six cosine-law solar cells mounted on the facet of the satellite. Horizon sensors, a fine sun sensor, and a star sensor serve as the accurate attitude measuring devices.

Attitude control is achieved through a passive gravity gradient boom, combined with two redundant active actuation methods. Slow attitude motion and course pointing to within one degree is achieved though magnetorquers. These comprise of air coils wound into channels in the solar panels on the sides of SUNSAT and others on the top facet of the structure. Accurate pointing and stabilization during imaging is provided by four servo-motor driven reaction wheels.

Flight Control

Flight control is provided by redundant heterogeneous computers. General flight management tasks are performed by an Intel 386-SL processor, backed up by an Intel 80C188EC processor. A T800 transputer is dedicated to the fine altitude control system, but its tasks can be taken over by the 386 in case of failure. Three additional embedded 80C31 microcontrollers provide further support for telemetry, telecommand and attitude control subsystems.

Telemetry and Telecommand

The telemetry data collection function and data transmission functions are duplicated for redundancy. Telemetry data can be collected from acquisition modules in each sub-system by either of the flight management computers. In case of flight

computer failures, a backup discrete component telemetry system is also available to feed simple formatted data streams to 1200 baud modems which can be switched to any of the transmitters. The telecommand system also has a backup system implementation with discrete logic components.

Power Systems

The power system is kept simple while providing for as many component failures as possible. Peak power consumption could reach 100 Watts so careful power management will be required. Time-outs are included on all transmitters and the whole satellite is reset to a safe state if the battery enters deep discharge.

Satellite Structure

The structure supplies mechanical support during launch and thermal and radiation protection in orbit. The satellite is constructed in a tray configuration with 11 trays stacked on top of each other with the sensors on the top plate. Both the top and bottom trays are milled from solid aluminium for structural stiffness. The bottom tray contains the batteries, charge regulator and the UHF and S-band power amplifiers.

Four sides for the satellite are used for solar panels. The bottom-earth-side carries antennas and launcher attachment ring. The top of the satellite houses the attitude determination sensors, UHF backup antenna, and the VHF canted turnstile antenna.

SUNSAT 2 and 3?

The University is working on the continuation of the SUNSAT program. Besides its extensive educational contribution, the program has contributed to the export of an imager to the Korean Advanced Institute for Science and Technology for inclusion in KITSAT 3 and a duplicate SUNSAT magnetometer has been bought by a company in Germany to be flown on the SAFIR-2 satellite.

Conclusion

SA-AMSAT, as a member of the SUNSAT Advisory Board, will increase the flow of information on SUNSAT as the launch approaches. SUNSAT is an extremely complex satellite with multiple sponsors to satisfy. The SUNSAT team will do its best to provide Radio Amateurs with access to services of this new satellite, and looks forward to getting to know new friends via SUNSAT.

Editor's Note: Many thanks to Hans and the SUNSAT team for providing Journal readers with this informative report. As the SUNSAT launch approaches monitor the AMSAT News Service and The AMSAT Journal for additional SUNSAT information. ■

On the Road with the Yaesu FT-847

Chuck Duey, KI0AG (*ki0ag@amsat.org*)

The recently released Yaesu FT-847 is certainly an excellent radio that has HF/6m/2m/70cm capabilities, but how does it do on the road? In the short six-day 26 grid square expedition, the radio met or exceeded expectations. It works well on all analog satellites, even with the limited antennas used during mobile operations. The additional HF and 6 meter bands can also make the slow wait between satellite passes go by faster.

The Yaesu FT-847 has all the modes needed for current analog satellites. It can do the reverse tracking needed by FO-20/29 and AO-10 along with the normal tracking required for RS birds. This is a radio that accomodates Modes A, B, J, and T (15m TX, 2m RX) all in one box. The addition of a sub-tune knob easily helps to keep the QSO on the same frequency for the Fuji OSCAR birds. While out in the wilds of the western states and without the use of any computer control I found everything I needed was in one box.

After saving pennies for a few months, the FT-847 became available and I put my name in the waiting list. When the radio finally arrived the box flew open and the antenna jacks got hooked up to the antennas at my home station. It took a little bit to figure out how to get the satellite mode to work, but after resorting to actually reading the manual it became quite clear. The factory default has FO-20/29 frequencies programmed, so that is what was tried first. The radio performed flawlessly up and down the transponder. The signal was clean and without the problems that are sometimes associated with mode J.

Soon after taking the radio out of the box, the LARC swapfest was being held and our local AMSAT group was going to set up a demonstration station. We used the Yaesu FT-847 for the station with just an eggbeater antenna. FO-20 was demonstrated from 5° after the rise to about 4° before setting (Figure 1). Other satellite modes were in the memories and were very helpful in explaining the different analog satellite modes. Also, showing the radio running off battery power and small antennas in the parking lot was quite a hit.

After testing it at home and at a swapfest it was time to take it on the road. I planned to travel through the states north and west of Colorado. I took a 70 cm Left Hand Polarized (LHP) antenna, a Right Hand Polarized (RHP) M^2 eggbeater and a 70 cm MFJ vertical. My 2 meter antennas were a M^2 eggbeater and a 5/8th wave MFJ whip while my HF antennas were supported by a large magnetic mount base for 6, 10, 15, 20 and 40 meter Hamstick whips. I also took an Arrow Antenna dual band satellite Yagi for AO-27 operations. *(Editor's Note: See KI0AG's "Portable Voice Station" in the March/April 1997 issue of The AMSAT Journal.)* To power the transceiver, a 100-watt solar panel was attached to the top of the luggage rack that charged three 65 Amp-Hour gel cell batteries in the storage compartment below. With all this equipment, there was still plenty of room for the essentials like food, sleeping gear, tools, and two spare tires.

The first real test of the radio on the trip was a western pass of AO-27 while I was in western Wyoming (DN42). The charge on my FT-530 HT was a bit low, so the Arrow antenna was hooked up to the FT-847. I lowered the power down to about 5 watts due to the strict power limitations of the Arrow handheld antenna. I also put on the headphones and sat on the tailgate while AO-27 came up right on time over the northern horizon. Tuning was easy even with the microphone in one hand and the antenna in the other. The discriminator meter was found to be very handy in keeping the tuner centered on the downlink. Also, the audio quality was much better than the HT, the *sub-audible* tones could be heard on some of the stations transmitting.

The next test of the FT-847 came in Utah on the Bonnieville Salt Flats during a FO-29 pass. *Wow...70 cm enhancement!!!* FO-29 came up on time for a low eastern pass while my computer was running showing the satellite footprint. I had a good QSO with someone in southwestern Utah, and he cleared off when FO-29 was getting low. Using the reverse tracking, a QSO on the east coast was found with only a few degrees left. By the time they acknowledged me, FO-29 was at zero degrees. I came back thinking it was too late, but he heard and copied my grid square. I got back to him on one more exchange before FO-29 faded away. I looked at the computer and FO-29 was -3°. Afterwards, I compared the computer to the GPS clock, it was correct and my Keplerian elements were only three days old! The salt flat enhancement enabled the radio to receive below the horizon using no preamps and a 70 cm eggbeater....WOW!

After Utah it was on to Wells, Nevada where it was a slow evening. So after a FO-29 pass

Yaseu FT 847 Transceiver.

it was over to the old HF bands where 40 meters was working well to the East and into Europe. There were several pile ups between the U.S. east coast and Europe while I found a gentleman in Florida calling CQ about 3 kHz away from a pile up. The digital filter was tuned on the radio, and he came in clearly allowing us a good 10 minute QSO. I was able to describe how windy and cold it really was in northern Nevada.

Leaving Nevada, the trip was a bit behind my planned grid square schedule. With many satellites it is easy to work the same grid squares but just not the on same birds. I wanted to work a few stations on AO-27 from DN14, DN15 but the Interstate does not go though much of these grid squares. Meanwhile, RS-15 was coming up at about the right time so it was off to a quiet corner of DN15. My initial location had a bit of noise from the nearby power line, so I moved just a bit further down the dirt road. The perfect spot was found - a field access road that had a 15° tilt. The car was parked so that the tilt aimed the 2 meter eggbeater up towards the satellite and the 10 meter whip as well. Once the bird came up to about 10° it was easy to get tuned up and calling CQ just using 50 watts into the eggbeater. RS-15 was working well with no signs of fading or poor signals. It took a while before the other stations looking for DN15 came on, and they did. All the stations calling sounded almost as good as RS-12 for a while, but the sweet spot started to fade. It was well worth the trouble to stop and make some contacts from DN15!

Entering Oregon it was on up to Spokane passing through DN05, DN06 and DN07 on the way, all via FO-29. It is very nice to have a setup that can hit those 10° passes reliably. From Spokane it was station wagon East into Glacier National Park. Many of the roads were closed, so all the passes were from the bottom of the canyons. One RS-12 pass was to the west out from a canyon. It was a very good pass with only one QSO going. To round out the day I had a nice quiet FO-29 pass while next to a lake.

The quietest place on the trip was in DN25. My station wagon was parked at a camping spot in Bitterroot National Forest. With the squelch on, the fan from the Yaesu FT-847 could be heard, but as soon as the headphones were put on or the radio was not squelched, the fan noise was not heard. Even at this quiet location, the fan noise was not a problem while operating. Through the trees FO-20, RS-12, and AO-27 were worked with only a slight loss on the horizon due to the trees. Also, 6 meters was mighty quiet, but I called CQ anyway. Much to my surprise someone came back, but they were only 60 miles to the north. Scanning through the rest of the bands and doing a few more HF contacts, the only interference I heard was from my computer.

Most thoughts of Yellowstone National Park are of a quiet and peaceful nature. However, at the campgrounds radio frequencies are not as quiet as expected. The main culprit was the motors on the heaters in the rest rooms. A motor that was only 100 feet away would put S-9+ noise on the 70cm band, and worse at lower bands. Others were less noisy, but while working 10 meters there was always one going off throughout the night. Even with this QRM, I made some RS-12 contacts. The noise reduction and the digital filter helped to bring out some stations. On the way out of Yellowstone and away from the noise, I was running a FO-29 pass when a Park Ranger pulled up. Something in his vehicle was hitting the downlink with a tone right where it was tuned. Before he wandered up to ask what was going on, the digital notch was turned on, and I signed off the QSO with a near perfect signal. After explaining that I was only talking on Amateur Radio Satellites, he went back to his car and drove off. All the time the notch was working well even with the frequency changes needed to correct for Doppler shifts.

This radio has a few good features but some drawbacks for VHF/UHF roving capabilities. The power and size for 6 meter, 2 meter and 70 cm can't be beat. It would be nice to have dual-band monitor instead of one band at a time. The filters and sensitive receiver help pull out signals missed by other rigs. Missing the 222 MHz band was a disappointment, along with not having a 23 cm option. It looks like the FT-736 still has a home for those two bands.

Overall, the Yaesu FT-847 is a versatile radio that can handle most anything on the road. The satellite modes work well even tracking the Doppler shifts by hand. The HF enables RS bird operation as well as being a good mobile HF rig. This radio should work out very well for locations away from the home QTH like Field Day, contest roving ,and the occasional grid square hopping trip.

Catch Ya' on the Birds!

73, Chuck, KI0AG ■

Preparing to Receive Phase 3D's 10.4 GHz Downlink

Josef Maier, OE3JIS (*oe3jis@eunet.at*)

This project was carried out during my preparations for a ground station to receive Mode X (3cm) downlink signals from the Phase 3D satellite. I was curious enough about new X band technology to identify components that are already available on the market for Phase 3D use. These components are relatively small in size and are so compact, that in my case, I was able to install the components in an existing transceiver.

Layout Basics

Various AMSAT publications and previous studies provide the following specifications on Phase 3D Mode X:

Downlink frequencies:

- Analog: 10,451.025 MHz to 10,451.275 MHz with center at 10,451.150 MHz
- Digital: 10,451.450 MHz to 10,451.750 MHz

Satellite transponder:

- PEP transponder: 50W
- Satellite antenna gain: 20 dBi
- Satellite EIRP: 37 dBWi
- PEP per QSO: 24 dBWi
- Path loss: 207 dB
- Ground station EIRP: -183 dBWi

Also note that below 1 GHz, transmission and reception of space microwave signals are disturbed by cosmic noise signals and above 15 GHz signals are disturbed by absorbtion from water vapor and water content and also from oxygen. However, the 10.4 GHz band is relatively free from these effects. Also, a lot of experience in the 11-12 GHz range exists from European satellite television technology that uses similar bands and equipment.

Microwave Antennas

The reception of 10.4 GHz signals requires high gain antenna dishes which usually must be homebrew constructed. The following dish construction options are available:

- Option A: Parabolic dishes with central reception/transmission feeds.
- Option B: Parabolic dishes with offset reception/transmission feeds
- Option C: Dishes with indirect feed construction (i.e. Cassegrain, Gregory and other backfire systems)

For amateur reception purposes the first two (Options A & B) are the most interesting types and ones that I have built, tested, and reported in this article. Figure 1 shows the approximate relationships for Option A between power gain, dish diameter and 3dB beamwidth in degrees for 10.4 GHz. Of course, bigger dishes result in higher gains but have a smaller beamwidth (in degrees). They also require more precise direction control of the dish to the satellite position. Therefore, the dish should be as small as possible for good signal reception.

Another advantage is that smaller dishes have less windloads. For example:

Dish Diameter	Projected Surface (sqm)	P max (wind velocity 100 km /hr)
30 cm	0.072	85 N
60 cm	0.28	335 N
90 cm	0.64	770 N

Meanwhile, an offset dish uses a section of the parabolic shape that is not symmetric to the center line. Figure 2 shows the center section of such a dish. This construction has the advantage of:

- No reception feed shadow on the dish
- No reduction in gain
- Easier to construct and to adjust the exact focus point
- More flexibility for future installation of a second feed for other bands.

The offset of the focus point is less critical as assumed for the performance. This gives the possibility to place a second feed for another band on the same dish. Also, small irregularities of the surface (like holes or bolt heads) have no remarkable effect on the efficiency of the dish. The relation of focal length to the dish diameter is essential also for the feed construction. The feed must have a beamwidth that illuminates the dish from edge to edge, typically at the -10dB points. If the beamwidth is too narrow not all the dish area is used.

There are dishes made of metal mesh construction suitable for the frequency in use. For the 10.4 GHz band, there is no advantage for such dishes. I used industrial-prefabricated aluminum dishes for my experiments and they are relatively inexpensive and available on the market.

Given these characteristics, the following homebrew satellite dish options are available to Radio Amateurs.

Ground Station Option A:

- Size: 60 cm (2ft) dish
- Gain: 33 dBi
- Signal Power/QSO: -150 dBWi
- Noise Temp 150K: 1,5 dB NF
- Noise Power in SSB: -173 dBW
- Signal-Noise Ratio: 23 dB

Ground Station Option B:

- Size: 30 cm (1ft) dish
- Gain: 27 dBi
- Signal Power/QSO: -156 dBWi

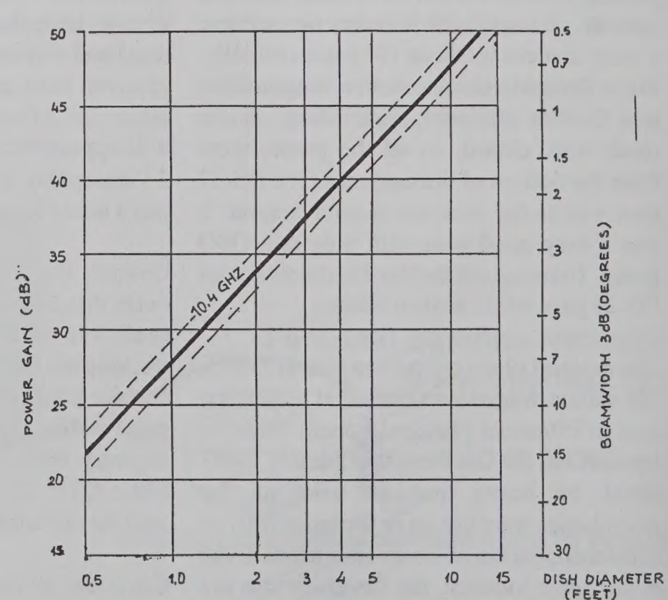


Figure 1. Approximate relationship between power gain, dish diameter, and 3 dB beamwidth (in degrees) for 10.4 GHz.

- Noise Power in SSB: -173 dBwi
- Signal -Noise Ratio: 17 dB

Remarks About Microwave Guides

Energy transport is done in the microwave bands on the surface of the conductor in thin layers. This is the well known as the *skin effect* of metal conductors. For the microwave bands, coax cables have extremely high losses and that is the reason why waveguides have to be used. The section of this guide can be rectangular or round. Other shapes are possible. The section surface is essential for the way that energy propagates down the waveguide. These are referred to as *modes*. A mode describes a pattern in which the field strength varies across the transmission line. In a well designed line only one mode exists, called the dominant mode. If the dimension of the waveguide is not appropriate (usually larger than the halfwave length), a variety of patterns occur making performance unpredictable. The waveguide should also be a good conductor with a high surface quality. For maximum performance gold plated construction is used. For example the relation between copper and steel waveguide losses in the 10 GHz region are expressed in dB with steel being 2.5 times higher in loss than copper. This is found in a waveguide 25.4x12.7mm external rectangular dimension (Waveguide Nu.16 dimension). As an example, copper pipes can also used as waveguides:

Outer Diameter	Wall Thickness	F1 min (Cutoff)	F2max (AttenuationFreq)
15mm	0.5mm	12.557MHz	16.404

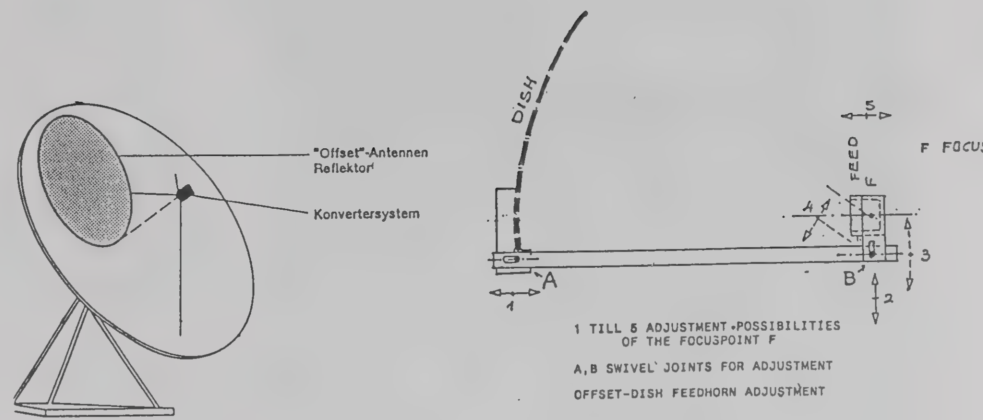


Figure 2. Offset dish feed adjustments.

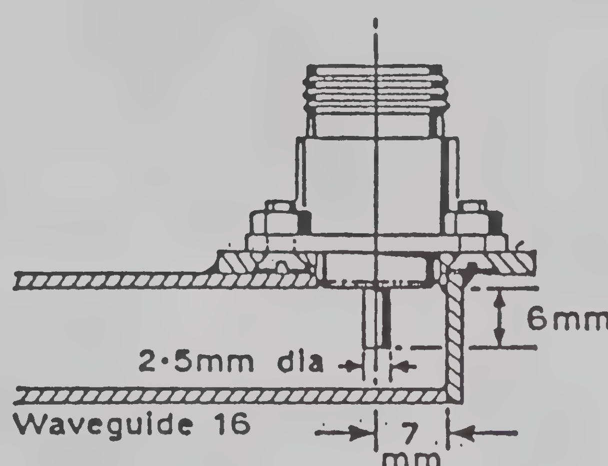


Figure 3. Waveguide transition.

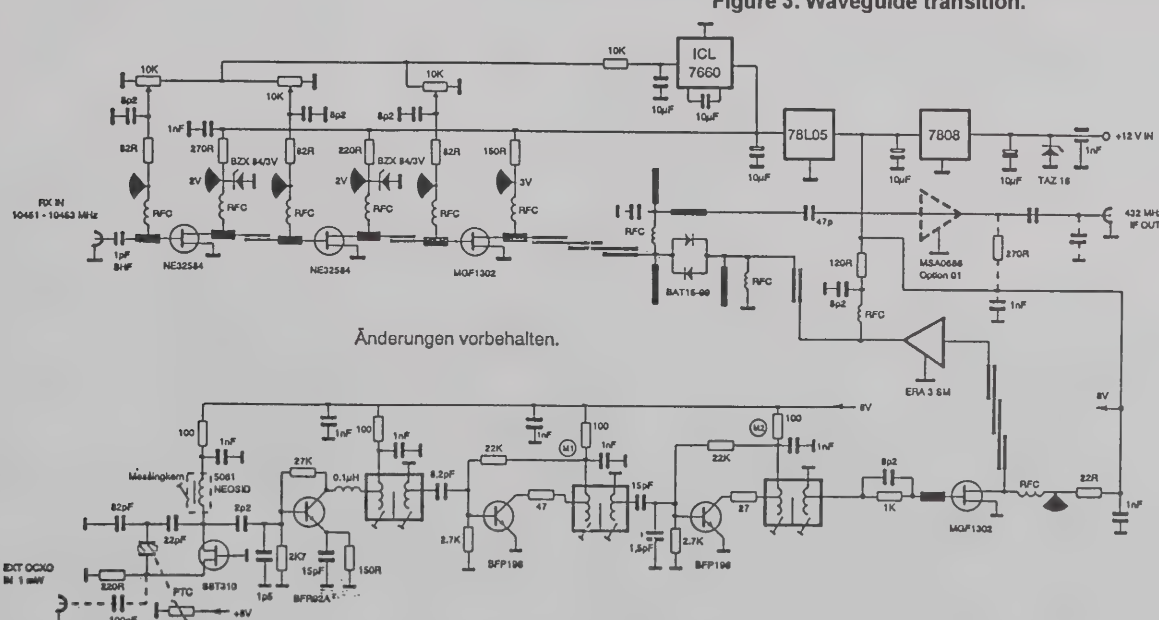


Figure 4. LNC MKU 10 OSCAR circuit diagram.

Figure 5. MKU 10 test beacon

22mm	0.6mm	8.452MHz	11.041MHz (3cm guide)
28mm	0.6mm	6.560MHz	8.569MHz

To transform the signal from the waveguide to a downlink signal converter a *waveguide transition* is necessary. With this device the signal is transferred to a coax cable connector from the converter. Such transitions require some testing procedures in a microwave laboratory and mechanical precision manufacturing. Figure 3 shows a waveguide transition for 10.4 GHz

Downconverter

During my experiments, I used the 10.GHz super low noise *MKU 10 OSCAR opt. 01* that downconverts signals from 10.451 GHz to 432 MHz. The gain is more than 30dB and my test results show 42dB. Noise figure is NF 1,15 dB at 18C. The MKU 10 downconverter is small with the dimensions of 30x 56 x74 millimeters and weighs only 95 grams. Power consumption 220 mA, 12-15 Volt DC. Figure 4 shows the circuit diagram of this downconverter that was designed by Michael Kuhne, DB6NT and is availiable at Kuhne Electronic, BRD (see Figure 11). (*Editor's note: In the United States this downconverter is available from SSB Electronics and Down East Microwave.)*

I used the 70cm portion of an all-mode Kenwood TR851 for receiving the downconverted signal and repeated the tests with an ICOM IC R 7000. The converter case is not weatherproof. Later plans call for placing the MKU 10 in an airtight soldered metal box for the outdoor installation. This weatherproofing is necessary to overcome the danger of dew point corrosions, which I have experienced during earlier S band installations.

10451.150 MHz Test Beacon

Unfortunately, at the moment, Phase 3D is on the ground and not in orbit. Therefore, to test if and how the assembly works, a test beacon is necessary. I ordered the MKU 10 from Kuhne Electronics with several modifications (Figure 5). The power was reduced to the minimum level of 10 mW and the oscillator crystal was trimmed to 10.41150 GHz which is in the middle frequency of Phase 3D's 10.4 GHz analog band. The size of the beacon is 111x55x30 millimeters and the weight is 160g. Laboratory test results revealed:

- Output power 10mW
- Spurious and harmonics less than 40dB
- DC current 220ma,12-15V

Even with this reduced power level, a simulation of the expected Phase 3D signal at ground level is not possible because of the short distance my calculations show that the beacon is much too strong. But there is a good possibility to control the function of the installation and in the future I will have an S-band beacon for such tests.

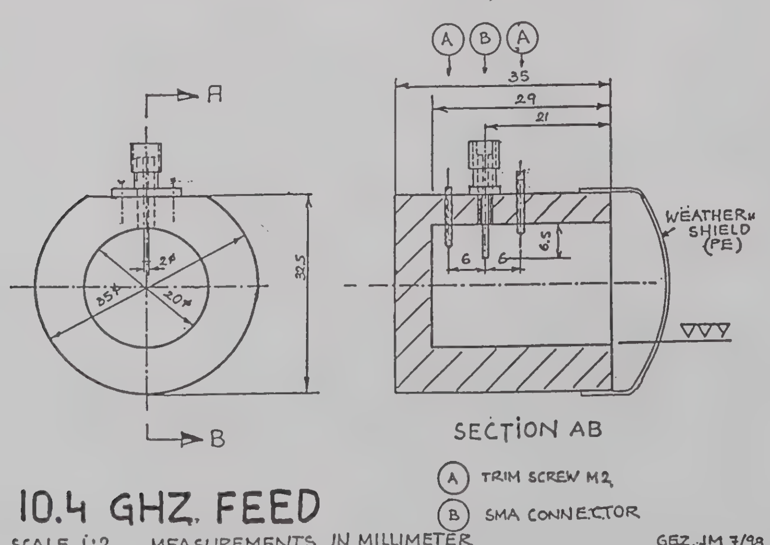


Figure 6. Section drawing for 10.4 GHz feed.

Feedhorn

Figure 6 shows a section drawing of the feed. The beamwidth of the feed is 140 degrees at the -10dB point; sufficient for the offset-dish solution I have identified. This feed was pretested in the laboratory and losses are very low. The material is aluminum and the resonant monopole is gold plated brass. Such feeds can be purchased ready made on the market.

Option A: Dish with Central Feed

I can buy this dish ready-made from Eisch Electronics. The dish is constructed by Procom of Denmark.

- Technical data: Diameter 48 cm
- Gain: 27 dBd

- F/D = 0.4
- Beamwidth: 6 degrees

At 10.4 GHz the SWR is about 1.6 (see Figure 7) Meanwhile, Figure 8 shows the dish from the front side, with the reflector soldered to the central waveguide. Figure 9 is a view from the backside with the waveguide transition, the converter, and the other test arrangements. The waveguide and the transition are gold plated.

Option B: Offset Dish Construction

This dish type is characterized with its elliptical circumference shape (Figure 10). The outside dimensions are 40 cm and 36 cm. The manufacturer is unknown to me, but it is a dish for digital satellite television that was inexpensively purchased. The feed (see the earlier description) is fixed with clamps and the whole feed position can be adjusted many ways (see Figure 2).

Testing These Dishes

At first I must state that these dishes have not been made with exact scientific methods. I started up the beacon and after a warm-up period of five minutes I heard a roaring S9++++ signal on the all-mode Kenwood TR851E at 432.150MHz. The high noise level was because of the high gain of 42dB of the converter at about S7 and was to be expected. But the signal strength was so high that the S-meter was on the pin. This first trial shows only that the system works on both dish types. Of course the distance of five meters is too small and there may have been some wall reflection. The next step was a field test over a distance of 1 km and these tests also confirmed that the both dishes work. Even this test showed strong S9+++ beacon signal readings. In moving the antennas up and down and left and right I could make some adjustments of the offset antenna feed.

The field tests had been repeated with an ICOM IC R 7000 as a receiver. The noise readings were reduced to S1.5 and the signal indications had been S9 to S9+. There was a difference of S7.5 to S8 values between the noise and the USB signal. As I mentioned before, the beacon was too strong for the simulation of the Phase 3D predicted values.

For my case, tests have also shown that the dish Option A of the downconverter with its high gain has too much reserve and would be unnecessary. But the noise level is no big problem for me, because I use a NF digital

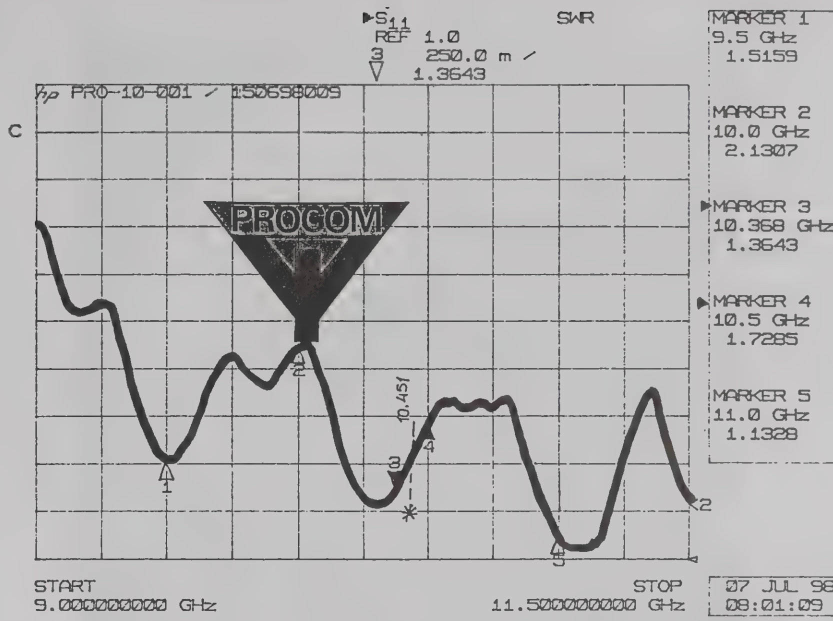


Figure 7. SWR diagram for Procom dish.

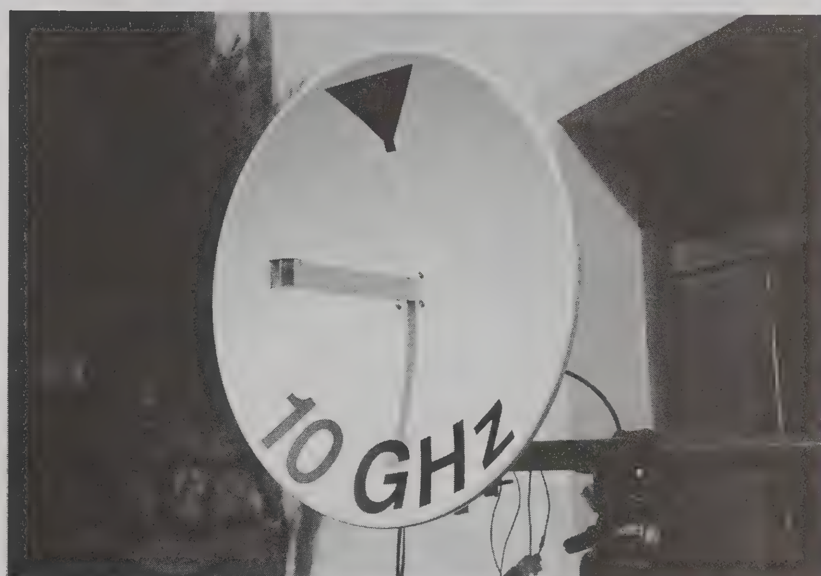


Figure 7. Front view of Procom dish.

filter that kicks out the noise to a great extent. But what delights me very much is the clear signal strength of the converter and the good reception S/N value.

Both types of antennas have a clearly defined polarization direction from the feed side. It was interesting to observe the effect of changing the polarization direction 90 degrees relative to the beacon. In most cases, the readings on an ICOM IC 7000 S meter changes 2 S values. If the space signal comes down with circular polarization, a good S/N reserve will also help a lot.

I intend to install the offset dish on the vertical rotating boom of my antenna system with a separate TV-dish standard actuator. I think I am ready for the Phase 3D X band. Hopefully this satellite will soon be in orbit!

Figure 9. Backside view of Procom dish.


Figure 10, Front view of offset dish.

Source References

1. Kühne Electronics, Birkenweg 15, D-95119 Naila/Hölle BRD, Germany. Telephone:09-288-8232 Fax:09-288-1768. E-mail:*kuhne.db6nt@hof.baynet.de*

2. Eisch Electronic, Abt-Ullrich Str.16, 89079 ULM Gögglingen BRD, Germany. Tel: 073-052-3208. Fax: 073-052-3306

3. Procom A/S, Vinkelvaenget 21-29, DK-3330 Gorlose, Denmark Telephone: 454-227-8484. Fax:454-227-8548

Other downconverter sources are:

- SSB Electronic USA, *http://www.ssbusa.com/*
- Down East Microwave, USA *http://downeastmicrowave.com/*
- TGN Tecnologies, International, Tenerife Spain ■

Sputnik Signals, Cold War, and Internet

In February, 1996, Roy Welch, W0SL, was contacted by Mr. Richard Melman, of Jeremy Issacs Productions in London. Jeremy Issacs Production is the same production company that produced the award-winning *World At War* series. Melman had performed an Internet search on Sputnik in hopes of finding additional sources of information for a documentary on the Cold War. During this search Melman found Roy's Sputnik audio recordings posted on the AMSAT WWW site. Melman wanted to interview Roy about these recordings and asked if Roy would give them permission to use the full original tape recordings. Roy agreed to this, and in March, 1996, they flew him from his home in Missouri to Washington, D.C. where he was interviewed and video taped in a hotel room in Georgetown.

The series, entitled 'Cold War', was commissioned by the BBC and Turner Broadcasting, and consists of twenty-four, 45-minute episodes that will begin airing on BBC-2 and CNN's Sunday documentary series, CNN Perspectives, beginning in September, 1998. The eighth episode is about Sputnik, and Roy appears in a 50-60 second segment of it. The original taping lasted about an hour and the major inquiry was about what Roy felt on the day Sputnik was launched. After finishing the interview with W0SL, the production team went over and taped Robert McNamarra. After leaving Washington the crew went to Russia and interviewed the people there associated with the Sputnik launch. The series is narrated by Kenneth Branagh.

Three years in the making, with a budget of nearly $15 million, 'Cold War' is the most ambitious production in CNN's 18-year history. Filmed in thirty-one countries, 'Cold War' features historic footage that in many cases has never been seen before by an international audience. Its hundreds of interviews include some with the era's key players— and many of the unsung heroes who helped shape modern history. The series is illuminated by the recollections of politicians, diplomats and by the memories of ordinary men and women across the world whose lives were bound up in the Cold War Struggle.

Hand(helds) Across the Sea via AO-27

Ray Soifer, W2RS

w2rs@amsat.org

In a previous article [see "Hand(helds) Across the Sea," *The AMSAT Journal*, March/April 1997],Paat Gowen, G3IOR and I described how we worked each other across the Atlantic via RS-10. We used hand-held FM transceivers for the 145 MHz uplink, portable 10-meter receivers and whip antennas. We sent chirpy CW by keying the PTT buttons of our HTs.

In contrast to RS-10, AO-27 utilizes Mode J (Mode VU in Phase 3D terminology), with a 145 MHz uplink and a 436 MHz downlink. As I have described elsewhere ("AO-27 From England and Scotland With an FT-50R and Whip Antenna," *The AMSAT Journal*, November/December 1997), it may be accessed quite readily with a dual-band FM HT and a dual-band whip antenna.

After returning home from the 1997 AMSAT-UK Colloquium, I became quite active on AO-27 from my home QTH, working as many passes as possible with my FT-50R and MFJ-1717 whip antenna from the backyard of my New Jersey house. One day, I heard Mike Seguin, N1JEZ, in Vermont working a station in Iceland. The window on AO-27 between New Jersey and Iceland was so short that I couldn't get the station's call. However, a query to Mike at *n1jez@amsat.org* quickly established that it was Jens Held, TF/DL7VTX/p in the grid square IP15.

Operating experience has shown that I need at least 9-10 degrees of elevation in order to copy useful signals through AO-27 with the FT-50R and MFJ-1717. Randy Kohlwey, N7SFI, tells me that he can work AO-27 down to about four degrees with an Arrow dual-band beam (which would be a bit large for many of the trips I take). Meanwhile, good fixed stations such as Mike's can go all the way down to the deck, but 9-10 degrees is my functional limit with the equipment I'm using.

The computer told me that there would be an AO-27 pass out over the Atlantic on August 29, 1997, with AO-27 reaching 10 degrees elevation at W2RS (FN20ww) and IP15 at the same time. I set up for it, waited for AO-27 to come over the horizon, and then with the bird up to about 9 degrees I called TF/DL7VTX. Bingo! Jens came right back, and we exchanged grid squares before he lost the bird. We were lucky: the pass was so far over the Atlantic that he and I were the only two stations on the satellite!

I was happy to work Jens, of course, but the true significance of that QSO was not apparent until his QSL card arrived via the bureau nearly a year later. He was also using a dual-band HT (a Yaesu FT-470 with 5W output) and a whip antenna! Jens and I had made it across the Atlantic with nothing more than a hand-held and a whip at each end.

Although Iceland lies within ITU Region 1 (Europe, the Middle East and Africa), and contacts with Iceland count as Europe for operating awards such as WAC, IOTA and WAE, some may argue that Iceland isn't *really* within Europe, but merely an island in the North Atlantic. However, the distance between Jens's operating location in Myvatn, Iceland (IP15mp) and my own works out to 4,446 kilometers (2,763 statute miles), which is actually farther than the distance between, say, Maine and Scotland.

With a lower limit of 9-10 degrees elevation at each end, that is within 100 miles or so of the maximum distance that it is possible to work via AO-27. However, a good fixed station at the other end of the path would add about 600 miles to that, so when I went back to England for the 1998 AMSAT-UK Colloquium, I resolved to try to work back to North America.

For this year's Colloquium, I made two improvements over my 1997 efforts during which I had been unable to work anybody through the heavy European QRM. The original-equipment 2W battery (FNB-40) was replaced by a 5W NiMH battery from Periphex (FNB-41M) and I asked G3IOR to listen for me, just in case. (Last year, I had made no schedules.)

It may have been the 5W battery, or just better luck, but I was able to make six AO-27 QSOs with five different stations during the 1998 Colloquium: Pat Gowen, G3IOR; Alojz Benko, OM3WAN/p in Slovakia; Burghaun Club Station HB0/DL0HUN in Liechtenstein; Wolkmar Junge, MU/DF2SS on the Channel Island of Guernsey, and two QSOs with Dave Houlden, G1OCN, in Dorset, England.My second QSO with Dave on August 1, 1998, occurred during a pass with low-elevation visibility over most of New England and eastern Canada while reaching about 11 degrees at the University of Surrey where the Colloquium was being held. At my request, Dave put out several calls of *CQ North America*, but nobody responded. Hopefully, we'll have better luck next year.

In my first year on AO-27 with the FT-50R and MFJ-1717, I've worked more than 100 different stations, of which about three-quarters were worked while standing in my backyard. Quite a few of these were also using hand-held transceivers, some with dual-band whips such as mine and others with Arrow antennas.I hope that this will not only encourage more amateurs to try AO-27 for themselves, especially those who have not tried satellite operating before, but that it will also encourage satellite builders to build and launch more easysats, including FM repeaters such as AO-27 as well as Mode A and Mode K/T CW/SSB birds such as RS-10 and RS-12. As RS-10 has already (regrettably) shown, the ones we have won't last forever.

There is some progress to report along this line, with ASUSAT, JAWSAT, SEDSAT, and SUNSAT in various stages of development. A few more, however, wouldn't hurt, and may well help to attract more interest in satellite operation as well as potential new members for AMSAT. ■

1998 AMSAT Field Day Competition Results

Andy MacAllister W5ACM

The 1998 AMSAT Field Day Competition was held in conjunction with the yearly American Radio Relay League (ARRL) Field Day in June. Rules for the AMSAT activity were similar to those posted by the ARRL, but with a few key exceptions. While the ARRL rules lump all satellite activity in one category, the AMSAT rules differentiate activity via different hamsats as separate bands. The AMSAT rules also provide bonus multipliers for digital satellite downloads and uploads of Field Day greeting messages.

The 1998 competition was very active. Submissions were up substantially, as were scores. Every available amateur radio satellite had Field Day participants in pursuit of contacts. Several DX stations joined in the activity. Three sent in reports this year including ZS6BMN, OZ7SAT and HR2KOS. DX stations are encouraged to participate in the AMSAT Field Day activity.

Without AO-13 some problems were noted with loading on the low-orbit satellites, but operation via AO-10 was excellent, if not fantastic.

The entry sheet was not modified this year and the rules were easily understood by most of the stations that submitted entries. There is still some confusion regarding digital-satellite messages. The only message downloads that count for Field Day are those that are addressed to ALL and were uplinked during Field Day as Field Day greeting messages. Dr. Viktor Kudielka, OE1VKW, pointed out that upload time stamps should be checked, duplicate field-day messages (identical length and contents) were sent, multiple, but different, field-day messages were uploaded from various stations, differing titles were used for field-day message uploads, and even messages announcing duplicate field-day messages were sent. Sorting out the acceptable messages from extra or bogus messages in the digital-satellite uploads was not easy.

Download listings and analog contact dupe sheets were required from all top-scoring stations this year. Several spreadsheets were submitted via e-mail and checked for errors and inconsistencies. If you have a high score next year, please keep good logs and dupe sheets. All top-scoring entries will be requested to provide at least dupe sheets and digital-satellite DIR listings. Some stations already send complete logs along with their entry sheet.

Many thanks to all of you that operated in this year's event. It was a great opportunity to show other Field Day participants how easy and exciting satellites can be. It was also a chance for some competition on the birds and an occasion to test hamsat radio gear and antennas in emergency conditions.

Per the 1998 AMSAT Field Day announcement, the first-place portable station using emergency power will receive a plaque at the AMSAT meeting in Vicksburg, Mississippi. Second and third place entries will receive certificates. The first-place home station running emergency power will also receive a certificate.

No rule changes are expected for the 1999 AMSAT Field Day event at this time. There have been Field Day rule discussions via amsat-bb on the Internet, and I have received some ideas for rule changes through the mail. What do you think? Please send any comments to *Andy MacAllister W5ACM, AMSAT VP User Services, 14714 Knights Way Drive, Houston, TX 77083-5640.*

1998 AMSAT Field Day Results

Place	Call	Pts.	Class	Group Name
1	K8AYZ	470	2A	L'Anse Creuse Amateur Radio Club
2	KD6OZH	448	1E	John Stephensen
3	K4BFT	421	5A	Huntsville Amateur Radio Club
4	N1JEZ	420	2A	Michael Seguin and crew
5	N2WM	291	3A	Sussex County Amateur Radio Club
6	OZ7SAT	281	2D	AMSAT-OZ
7	N8AM	272	1D	Tom Flowers
8	K5DX	257	2A	AMSAT-Houston & Texas DX Society
9	ZS6BMN	252	1D	Jan Hattingh
10	W9LO	239	4A	The Ozaukee Radio Club
11	W5IU	228	3A	Lockheed Martin / Kilocycle Clubs
12	K2CT	223	4A	Albany Amateur Radio Association
13	WA0VTU	219	2A	Pike's Peak & Mountain ARC's
14	K4RS	203	2A	Fort Pierce Amateur Radio Club
15	K4TN	170	3A	Brandon Amateur Radio Society
16	K7EFA	127	1A	Yellowstone Radio Club
17	W5XX	108	3A	Vicksburg Amateur Radio Club
18	N4DAZ	104	1A	Central NC DX Chasers
19	NX2Q	84	1A	N2HUC & NX2Q
20	N7SFI	81	3A	N7SFI, KC7KSA, KC7LNT & KC7QFS
21	W9KFB	80	1D	Ron Cox (W9KFB) & Majid Lodhi (KE9UN)
22	KD4SFF	51	1D	Albert K. Lark
23	W7SA	48	4A	Catalina Radio Club
24	W0DK	45	3A	Boulder Amateur Radio Club
25	N6AS	40	1D	Phil Crosno
26	HR2KOS	33	1A	Lone Ricker
27	N5TZ	32	2A	Armadillo Intertie
28	WA0JBW	13	2A	Greg N0ZHE & WA0JBW ARC
29	VE3RAM	9	3A	Ottawa Valley Mobile Radio Club
30	K5HOU	9	2A	Clear Lake & Brazos Valley ARCs
31	K6HAI	9	3A	North Shores Amateur Radio Club
32	WA3NAN	6	3A	Goddard Space Flight Center ARC
33	K5OE	4	1A	Gerald Brown

Field Day Reports

Tom Mathison WU8C for K8AYZ: This was the best AMSAT Field Day ever! AO-10 couldn't have performed any better. I have never heard this satellite so busy! The other analog birds I used, FO-20 and FO-29 were a tremendous challenge with their Doppler effect. My station and satellite operation gave many newcomers access to something they have never worked before. I am looking forward to next year. Congratulations to all on the sat's.

John Stephensen for KD6OZH: It was refreshing to have AO-10 operational this Field Day. Let's hope that Phase 3D is up next Field Day.

Tim Cunningham N8DEU for K4BFT: Putting the Digital PacSat points together was a difficult task. We finally decided to put all the contacts on a spreadsheet and extract information from the files to take a look at what we had to deal with.

Mike Seguin for N1JEZ: We had five AMSAT members operating this year under the callsign, N1JEZ. The ops were Tom N1GZZ, Mike N1JEZ, Beau N1MJD, Cliff N1RYS and Bob WE1U. It was nice to have AO-10 available for about half of Field Day this year. Did anyone else notice the eclipse of AO-10 at about 0337 UTC?

RS-15 was in great shape. I believe it has to do with the fact that the beacon is no longer functioning. I didn't think the downlinks were any stronger, but they remained constant despite heavy use. I think the power previously used by the beacon was available for the transponder instead.

We experienced a computer problem about eight hours into the contest and lost four hours worth of contacts. When Field Day was over, I was able to search the hard drive and retrieve the lost portion of the log (sigh of relief).

We had great fun combining the N1GZZ and WE1U digital stations into one covering both 1200 and 9600 baud birds. There seemed to be fewer extra messages this year and traffic flowed easily. We were not successful at operating 9600 baud simultaneous to Mode B transmit, but we were able to convince our analog operators to shut down their AO-10 contacts during digisat passes.

John Santillo for N2WM: We worked lots of stations. It was a good competition!

Bent Bagger OZ6BL for OZ7SAT: The orbits for the analog birds were not suitable for contacts into North America, e.g. we had AO-10 to the east all the time. In fact, the only FD station from North America we logged was N1JEZ.

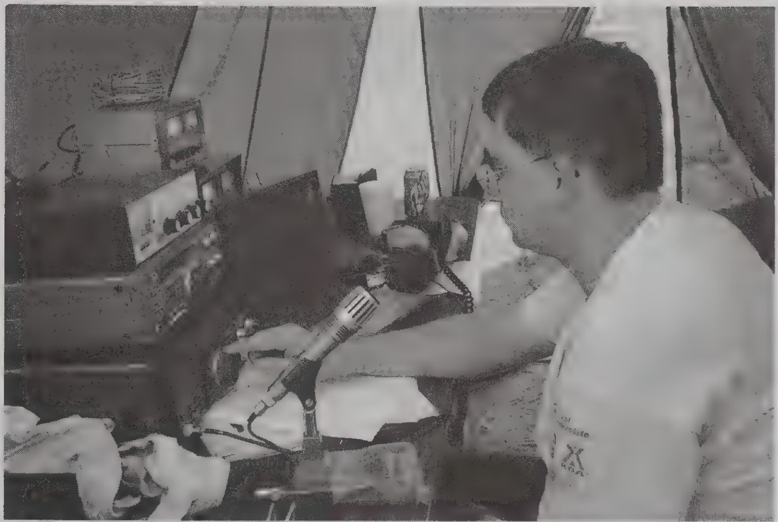
We did better on the digital birds where we were close to making a clean sweep except for UO-22, where we had difficulty closing the directory. I wish that more care was taken not to upload duplicate messages and we missed a couple of greeting messages because they were large, greater than 3 Kb, and thus were rejected by PG's download rules. I guess that the greeting itself was accompanied by a picture.

Tom Flowers for N8AM: I read my note from last year's contest and was able to up my score this time. Isn't AO-10 great after all these years!?!

Andy MacAllister W5ACM for K5DX: Last year we were all analog. This year we set up for both analog and digital satellites, with a much better score. We had a wiring problem between my antique TNC and the new Yaesu FT-847 that precluded any digisat transmissions, but still managed a lot of complete downloads just by *listening*. AO-10 was the star performer this year. It was amazing! I had expected FO-20 to be the workhorse analog satellite, but it came in a distant second to AO-10. Next year we'll try for some digisat uploads.

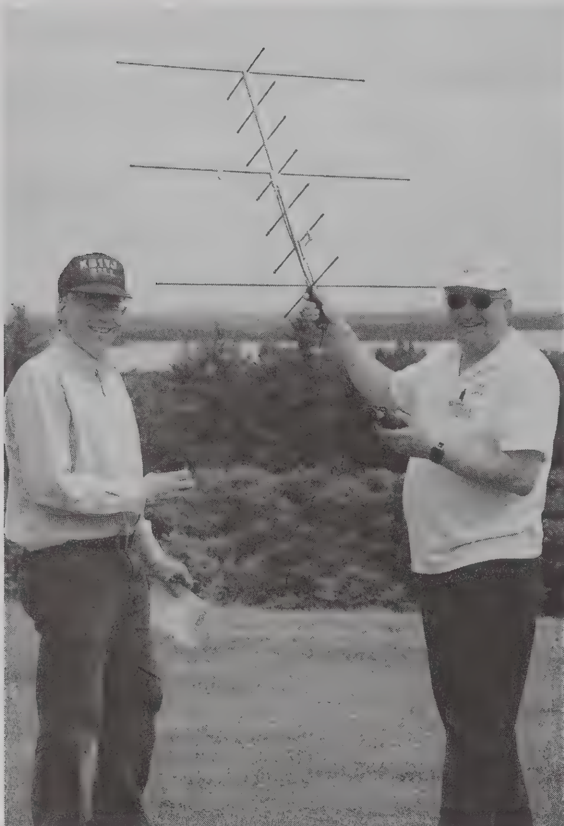
Jan Hattingh for ZS6BMN: It was good to see an increase in the number of FD messages on the digital satellites, especially from other parts of the world. It was fun to have something different to do on these satellites.

Field Day WA0JBW satellite operations (photo by Greg Wycoff, N0ZHE)



Vince Fiscus, KB7ADL operating the K7EFA satellite Field Day Station. (photo by Wayde Carlson, N7KVW)

Field Day at N1JEZ. Tom Whitney, N1GZZ tightens the analog uplink antenna as Cliff Lang, N1RYS inspects its alignment.



Satellite greetings from New Hampshire! Bill Clapp, KB1YJ (l) and Keith Baker, KB1SF using an Arrow Antenna to work Mike Seguin, N1JEZ in Vermont from the Port City ARC/Great Bay Amateur Radio Association Field Day site.

Phil, N2HUC, Al, NX2Q, and Matthew at the NX2Q satellite station at High Point State Park, New Jersey.

Jan Hattingh for ZS6BMN: It was good to see an increase in the number of FD messages on the digital satellites, especially from other parts of the world. It was fun to have something different to do on these satellites.

Gary Bargholz N9UUR for W9LO: A wonderful time was had by all, even with the thunderstorm that came through Saturday night with 60-MPH winds and over an inch of rain in an hour. One HF tower blew over, but the satellite tent stayed up. We packed the gear back in the cars and waited it out.

If Wisconsin 9 Lousy Operator sounded a bit strange on some of our contacts, sorry, we try to let ANYBODY run the station. For most, it's their only chance to talk on a *bird*. Thanks and 73!

Keith Pugh for W5IU: This year's Field Day satellite effort was marked by change. Many long-time operators were either out of town or otherwise unavailable. Ray WA5QGD and Keith W5IU were the primary hamsat chasers this year. Both are the proud owners of new FT-847s, so that was the rig of choice. Ray brought his computer and Keith brought the rest. Ray had been experimenting with digisats on the new rig. Our score was not the best, but we now have a better understanding of the new rig after several bouts with cockpit trouble.

Quite a bit of interest was stirred up among some of the new operators. This, coupled with the knowledge gained about the FT-847, made our AMSAT Field Day '98 effort a real success.

David Jones W2GDJ for K2CT: The digital satellites continue to be the spotlight of interest during Field Day. AO-10 provided many contacts for first-time satellite operators... can't wait for P3D!

Tom McDaniel N0NTX for WA0VTU: Great fun! We also tried to work RS-12, but the Novice/Tech station was a little too close. My only complaint is that I would have liked to have seen more digital stations play!

Roger Snyder for K4RS: The Fort Pierce (Florida) ARC had a new Field Day site this year. We moved to the campus of the Indian River Community College. We could not have asked for a better location. The staff at IRCC provided superb support and it was greatly appreciated.

This year was my fifth attempt at working satellites during Field Day. Most of the bugs have been worked out and I am happy to see the score rising each year. This year better antennas a new preamp helped considerably. The focus of operations this year was the 9600 baud digital birds. I was glad that KO-25 was operational again in time for the weekend event. I still have some problems receiving UO-22 and plan to be better prepared next year. I sure wish I could claim the points for all the duplicate messages downloaded. I counted 12 messages from one station on KO-23 alone! We had lots of visitors to the satellite station. The local newspaper sent a reporter and photographer by early on Saturday afternoon. The story appeared on the front page of the Sunday edition. Needless to say, the number of visitors picked up considerably. As usual, the food was great and everyone had a good time. I am really looking forward to next year.

Vincent Fiscus KB7ADL for K7EFA: AO-10 was hot in between bouts of QSB. I really enjoyed working everyone on the satellite this year. There are a lot of fine operators out there.

Russ Tillman K5NRK for W5XX: Vicksburg High School Football Stadium set up, heat, good food, friends and visitors, humidity, lots of fun with AO-10, mosquitoes, a late night AMSAT symposium planning session while waiting for passes, fire ants, early morning FO-20 passes, take down and a Sunday afternoon nap!

Gene Schmig KQ4AV for N4DAZ: The Central North Carolina DX Chasers were back again this year operating class 1A emergency power from Alamance County, North Carolina. We didn't get a chance to work all the analog satellites, but AO-10, AO-27 and FO-20 did net us 47 voice and 19 CW contacts. It was good to hear so many stations on the air. Field Day certainly demonstrates how well prepared the hamsat community is when it comes to operating in emergency conditions.

Ron Cox for W9KFB: AO-10 worked well and its pass was great for Field Day. FO-20 and FO-29 did well also. We used a new software program called MacDoppler this year on a 7100/80AV Power Macintosh. The new software worked great for antenna AZ-EL and Doppler control. Signals on FO-20 and FO-29 were as stable as AO-10 on the ICOM IC-820H.

Albert Lark for KD4SFF: I had to stay home this year because I was on-call at work. AO-10 was packed like the good old days on AO-13. Stations were calling me even while I was tuning up in the upper portion of the passband.

Larry Brown NW7N for W7SA: I worked with Dave Burnett WD8KRV this year. We used a Yaesu FT-736R with two-meter and 70-cm beams on tripods. AO-10 was loads of fun.

Chuck Duey KI0AG for W0DK: It was perfect weather in Colorado for Field Day! We had clear skies, but it was not too hot, great for solar panels. I kept so busy on the satellites, six meters and VHF/UHF, that I only did ten HF contacts.

Phil Crosno for N6AS: From my home in Salinas, California, I used an eight-foot wooden stepladder in the driveway to mount the antennas.

Rick Denis for HR2KOS: Fun! Fun! Fun! This year I had the most fun so far for a Field Day, thanks to AO-10's excellent condition. It was the first time that it was really usable for me. I enjoyed giving a new DX country to many, and I got a new one for myself! I look forward to next year's event as I know it can only get better every year.

Harold Reasoner K5SXK for N5TZ: It was a very good Field Day operation this year. We had lots of fun and introduced several hams to amateur satellite communications.

Greg Wycoff N0ZHE for WA0JBW: Operations on the LEO birds were harder to work than via AO-10 since I was not using any rotors for AZ-EL. I had to aim the antennas ahead of the satellite and wait for it to cross in front of me. AO-10 was in great shape, but I had to go for closer ranges after apogee since I was running only 25-Watt rigs. It was windy, but we had lots of fun, and that's what it's all about.

Clare Fowler VE3NPC for VE3RAM: We (VE3NPC, VE3IQ and VE3DY) operated Field Day QRP with a minimum station. The transceiver was a Yaesu FT-726R running about 10 Watts maximum. Homebrew antennas of W1JR design with five elements on 70 cm and four elements on two meters were mounted on a portable tripod with volunteer *armstrong* rotation. The operating position was on a piece of plywood pulled out and resting on the floor at the back of a station wagon. The vehicle's battery was used to power the transceiver and homebrew preamps. Setup and take-down time took less than ten minutes. We only worked daylight passes, and had no trouble receiving good signals from the satellites. The real challenge turned out to be getting a contact in before the satellites got desensitized by all the uplink signals that pushed the satellite receiver threshold above our weak uplink signal. While our score was low, we demonstrated that even under very adverse satellite operating conditions, you do not need big antennas, rotor systems, power amplifiers, large power supplies and multitudes of cabling to work the birds. On tests before Field Day, good QSO's were easily made on overhead passes with our station.

Dave Guimont WB6LLO for K6HAI: The North Shores ARC in San Diego, California, has garnered Field Day points for satellite operation for over 12 consecutive years. The year's contacts were made via FO-20. We got our ARRL 100-point contact with AA7A. We made several more *insurance contacts* and then concluded satellite efforts. We used two homebrew quadrifilar antennas mounted at a fixed elevation of 45 degrees. They were manually rotated on a ten-foot mast. They remained in place for all of Field Day, and always attracted a crowd. Though our contacts were at a minimum, the PR value of the antenna installation was more than worth the effort.

Gerald Brown for K5OE: I had big plans this year. This was to be my first year working the birds on Field Day. Because of antenna restrictions in my neighborhood, Field Day was actually an opportunity to use some temporary, rotatable outside antennas. The system included a three-element beam for ten meters, a four-element beam for two meters, an *eggbeater* for two meters and a pair of eight-element quagi's on 70-cm, set for RHCP. Because of my hectic work schedule, I didn't have much time to practice with the temporary set up, which became painfully obvious. After blowing out my new TenTec two-meter transverter for mode A uplink by applying 100 Watts to the input, and connecting 12 VDC to the input of my ICOM IC-490A, I was left with few options for satellite contacts. With only 5W on 15 meters for RS-12 Mode K, I got no takers. Keying my two-meter FM rig for Mode A got the same negative results. My AO-27 contact was questionable, and thus not counted. I fixed the transverter and the ICOM rig in time to make four phone contacts via RS-12. Fortunately all it took was a diode and a resistor for the transverter and a fuse for the IC-490A. The only final thought I have this whole affair is: I plan to do better next year! ■

Russ Tillman, K5NRK (l) and Eddie Pettis, N5JGK (r) at W5XX Field Day site, Vicksburg Gator HS Football, Stadium, Mississippi. (photo by Phillip Fortenberry, N5PF)

Harold Reasoner, K5SXK and Ray Hoad, WA5QGD at W5IU Field Day site, Fort Worth, Texas.

Gerald Brown, K5OE working RS-15 via key using a three-element downlink homemade beam.

Whole Orbit Data: The Fever Thermometer of the Satellites

Franz Bellen, DJ1YQ

Translated by John Bubbers, W1GYD

Editor's Note: This article originally appeared in the May 1998 issue of the AMSAT-DL Journal. Many thanks to Franz Bellen, DJ1YQ and Frank Sperber, DL6DBN for allowing us to reprint this article.

Not only do we humans exist on the Earth from the Sun's energy, but so do our satellites in space. The Sun's energy is transformed to usable power by the solar cells located on the satellite's outer surfaces. The cells (arrays) charge a battery that then supplies all the associated requirements. It also functions as a battery during varying sun radiation periods so that it has sufficient power available at all times for the on-board electronics.

Since this mini powerplant is important to the life of a satellite, the operation of the system must be monitored constantly. The on-board-computer (OBC) acquires the appropriate data parameters and transmits them back to Earth. During a pass data can be downloaded. The WiSP program, which is available from AMSAT is well suited for the 9600 baud satellites such as UO-22, KO-23, and KO-25.

In order to get an overview of the most important data over a longer period, the data on the satellite are gathered for a predetermined time and stored in files. These files can be read from the mailbox.

For example, UO-22 stores two data files next to files for other purposes with the identification WD (Whole Orbit Data).,This files have a cycle time of either five seconds and a file size of 86401 bytes, or a cycle time of 30 seconds and a file size of 54712 bytes.

Evaluation of a WD File

The author downloaded and evaluated file WD082997 from UO-22's mailbox.

This file contains the following data, which are captured in a 5 second time cycle:

- Channel 1: Array Voltage
- Channels 0, 8, 16, 26: Array Currents in the Arrays +X, -X, +Y, -Y
- Channels 4, 12, 20, 29: Temperatures of Arrays -X, +X, +T, -Y
- Channel 11: Battery Current

The satellite files are binary encoded and have to be decoded with appropriate software. Chris Dixon, GW6CZZ, was kind enough to make the program UNWOODP.EXE available to the author. The file decoded with this software appears in Figure 1.

The acquisition date, beginning and ending times, as well as cycle time are indicated in the file header. After the cycle time the channels are presented which were contained in this file.

The nine digit number after $T indicates the time in seconds after the date of 01-01-1970. Thereafter, follow the ten entered channels. The digit after the channel number under consideration is the measured value, which must still be recalculated into its true value using an appropriate conversion equation for each dedicated channel. For this, the author has written his own software which organizes the results so they can be read using *Harvard Graphics*. A part of such a program result is shown in Figure 2.

Graphic Presentation of the Measure Values

The following satellite parameters provided as Figure 3 result in the following figures.

Figure 4 shows the illumination factor for UO-22 from 1:00 UTC to 7:00 UTC (360 minutes). During this time the satellite orbited through the earth's shadow four times, during which time the illumination goes to zero. The dark periods last approximately 31 minutes. They are during:

- 01:27:00 until 01:58:00 UTC
- 03:07:30 until 03:38:30 UTC
- 04:47:30 until 05:16:30 UTC
- 06:28:00 until 06:59:00 UTC

The fact that during this time the solar cells do not deliver any output is confirmed

```
$H UoSAT-5 WOD Survey.
   Standard ASCII file output.
$H Start time: Fri Aug 29
               01:00:01 1997
$H End time  : Fri Aug 29
               06:59:55 1997
$H Period    : 5 seconds
$H Channels  : 1 0 8 16 26 12
               4 29 20 11
$I 5
$F uo5tlm.cfg
$C 10, 1, 0, 8, 16, 26, 12, 4,
   29, 20, 11,
$T 872816401 1, 3020 0, 1562 8,
   7 16, 7 26, 8 12, 1229 4,
   1195 29, 1249 20, 1177 11, 1910
$T 872816406
```

Figure 1. UO-22 telemetry decoded using UNWOODP.EXE

Eingabe-File: 97082997.5aw

Channels

1	0	8	16	26	12	4	29	20	11
Volt	mA	mA	mA	mA	Grad	Grad	Grad	Grad	mA
41.0	471.9	-2.6	1.1	8.2	7.2	9.6	5.8	10.9	256.1
41.1	468.3	-2.6	1.1	8.2	7.5	9.5	5.7	10.9	250.5
41.2	437.3	-2.6	11.9	8.2	7.8	9.4	5.5	11.0	248.6
41.4	405.4	-2.6	40.7	8.2	8.2	9.2	5.4	11.1	244.8
41.5	374.1	-2.6	71.5	8.2	8.6	9.1	5.3	11.2	250.5
41.6	347.3	-2.6	105.4	8.2	8.9	9.0	5.2	11.2	239.2
41.7	311.9	-2.6	133.5	8.2	9.3	8.9	5.1	11.2	244.8
41.8	281.2	-2.6	164.4	8.2	9.7	8.7	5.0	11.2	242.9
41.8	251.1	-2.6	194.0	8.2	10.1	8.6	5.0	11.2	237.3
41.8	226.0	-2.6	225.8	8.2	10.4	8.4	4.9	11.2	237.3
41.8	195.1	-2.6	252.7	8.2	10.9	8.3	4.9	11.2	239.2
41.9	165.9	-2.6	280.6	8.2	11.2	8.1	4.9	11.2	239.2
41.8	140.2	-2.6	308.1	8.2	11.6	8.0	4.9	11.2	239.2
41.8	117.3	-2.6	337.2	8.2	11.9	7.8	4.9	11.2	235.4
41.8	87.2	-2.6	360.6	8.2	12.2	7.7	4.9	11.2	233.5

Figure 2. Tranformation of UO-22 file 97082997.5aw into tabluar form.

```
- Start: 29.08.1997 / 01:00:01 UTC
        / Umlaufnummer 32095
- Ende:  29.08.1997 / 06:59:55 UTC
        / Umlaufnummer 32099
- Umlaufzeit: 100.203 Minuten
- Inclination: 98.3 Grad
- Exzentrizität: 0.00086090
- RAAN: 299.0 - 299.3 Grad
- Solar Elevation: 35.8 - 35.7 Grad
- Solar Azimut: 119.0 - 120.0 Grad
- Sonnenwinkel: 113.2 - 113.9 Grad
- Beleuchtungsfaktor: 91.9 - 91.4 %
```

Figure 3. UO-22 satellite parameters.

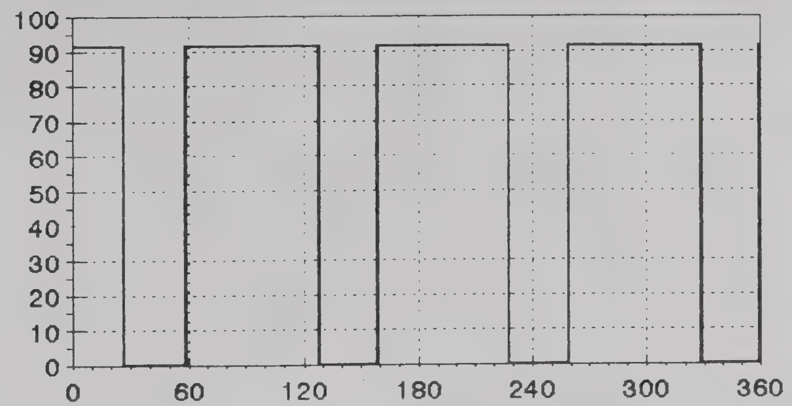


Figure 4. UO-22 Illumination - Time after start of measursement (in minutes).

in Figure 5. This figure shows the individual currents from the four arrays. The maximum current yield from each array is nearly 1 Amp. After a rapid rise in the course of an orbit, the current goes into a slow decline to 400mA. Figure 4 does not resolve the individual values; this will follow below.

Channels 4, 12, 20, and 29 show the temperatures of the satellite's four arrays. Figure 6 shows the graphic values. Because of the sun's radiation the temperature climbs to nearly 30 degrees Celsius. In the Earth's shadow they fall to -30C. The array temperature affects the efficiency of the solar cells.

The array's voltage is 42 Volts. See Figure 6. In the shadow it falls to the battery's 14 Volts.

The charge-to-discharge current ratio can be gathered from Figure 7. An evaluation of the three orbits gives the values shown in Figure 8.

One can recognize the built-in safety factor. The discharge current is 10 percent less than the charge capability.

Since the graphics are based on a 30-second resolution, the variations in the table values are attributable, for the most part, to the digital approximations of the evaluation.

The discernible signal interruptions in Figures 7 to 9 are examined more closely in Figures 10 and 11. These graphics were created with a time period of 5 seconds.

Figure 9 shows the current and temperature of the +X array for one orbit (100.2 minutes). The satellite was in the earth's shadow until 01:58:00 UTC. The current then jumps between zero and a peak value until 03:07:30 UTC (Minute 127.5).

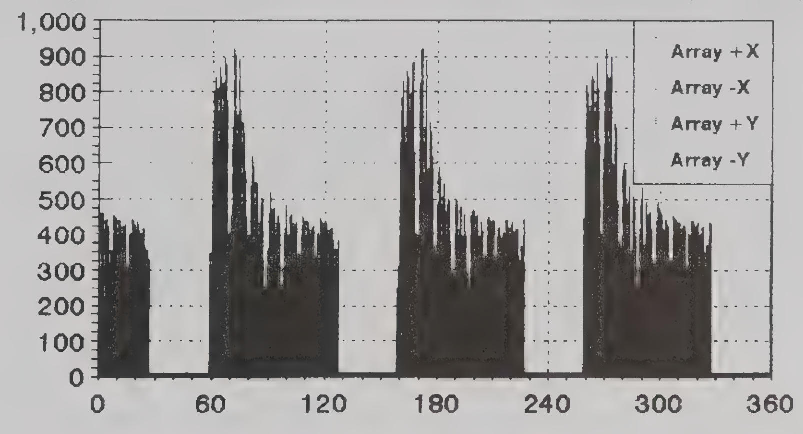


Figure 5. UO-22 Current (in mA) - Time after start of measurement (in minutes).

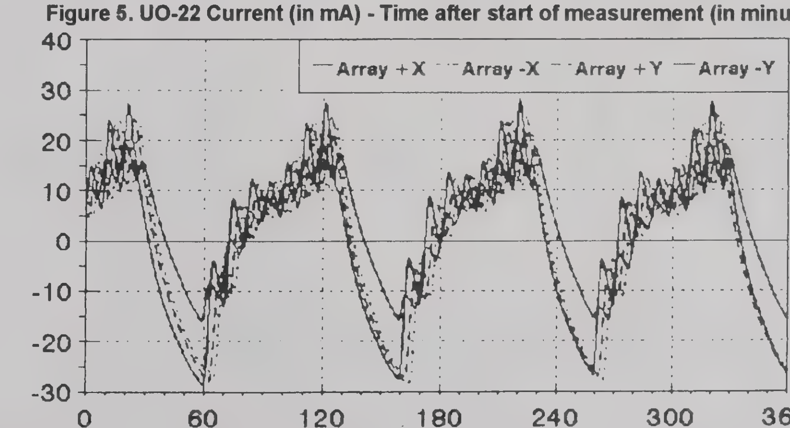


Figure 6. Array Temperature (in deg C) - TIme after start of measurements (in minutes).

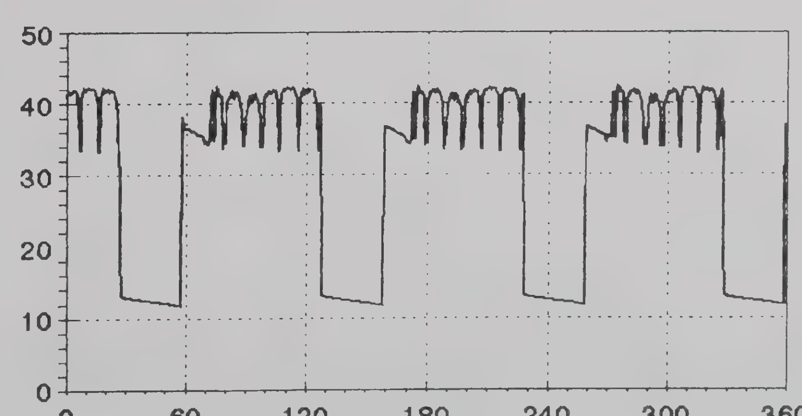


Figure 7. UO-22 Voltage (V) - Time after start of measurement (in minutes).

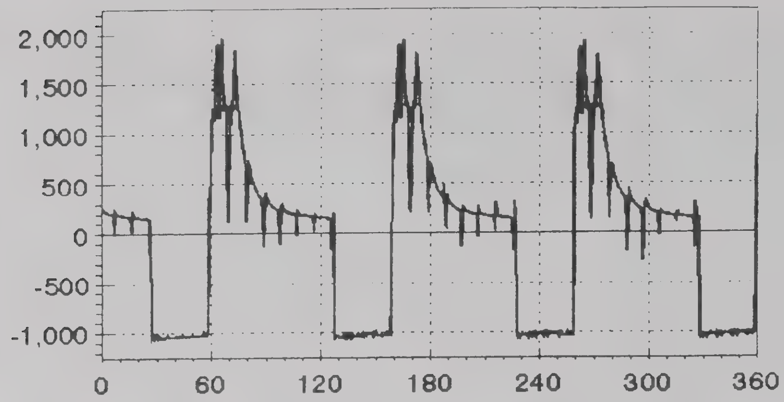
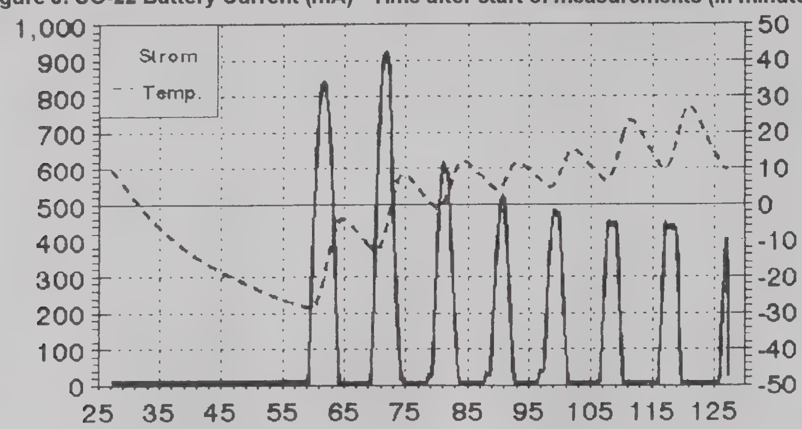


Figure 8. UO-22 Battery Current (mA) - Time after start of measurements (in minutes).



Fiugre 9. UO-22 Current (dash line) and Temperature (solid) in Deg C - Time after start of

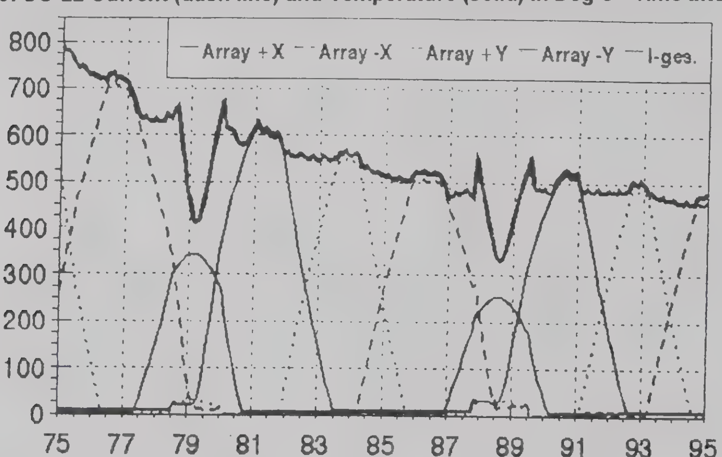


Figure 10. Detailed view of UO-22 Current (mA) - Time after start of measurement (in minutes).

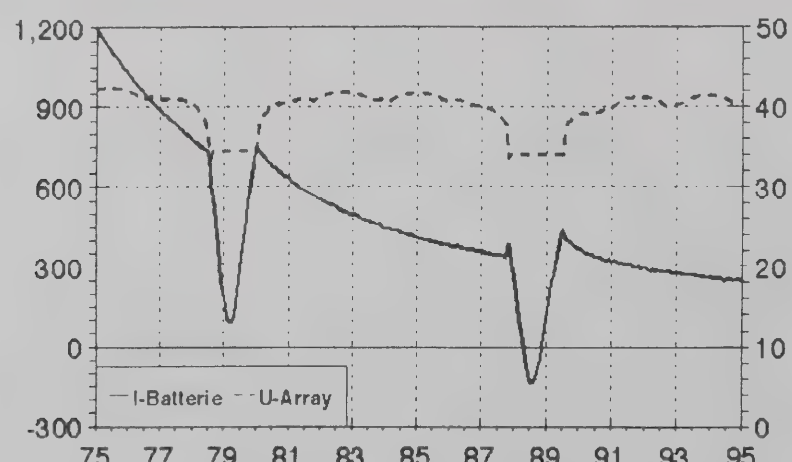


Figure 11. Detailed view of UO-22 Battery Current (dash line) and Temperature (solid line) in Deg C - Time after start of measurement (in minutes).

The reason is that UO-22 rotates about its z-axis. Consequently, each array demonstrates a similar condition.

In Figure 10 the resolution time was again increased. This figure shows all four array currents between minutes 75 and 95 of the observation period of 360 minutes. It can be assumed from this, that the satellite rotates at a spin rate of 9.3 minutes. The -Y array delivers the least current. The summation curve shows a clear drop.

Figure 11 shows the condition of the battery and the array voltage for the same time period.

Summary

The operational data of a satellite are continuously available and can be downloaded from its mailbox, as in the case of the 9k6 satellites. As an example, the Whole Orbit Data File WD082997 from UO-22 was downloaded and evaluated graphically. This file gives information about the energy housekeeping during a six-hour period. A data summary follows each month for UO-22. The files for the months of August to December 1997 were read out and evaluated by the author.

They show a nearly uniform condition, so that the previously developed graphics can be viewed as being typical for the satellite.

The suggestion for this article came from Norbert Notthoff, DF5DP, to whom I express my gratitude. ■

Results of the AMSAT Board of Directors Election

AMSAT-NA Corporate Secretary Martha Saragovitz has announced the results of the annual election for AMSAT Board of Directors. A total of 1,238 members cast ballots in this year's election and the results are as follows:

- Tom Clark, W3IWI - 1063*
- Keith Baker, KB1SF - 1005*
- Andy MacAllister, W5ACM- 851*
- Barry Baines, WD4ASW - 657#

The three candidates receiving the highest number of votes (*) were elected to serve on the Board for two years. Barry Baines, WD4ASW, the fourth highest vote getter (#) will serve as the alternate until the next election. The newly elected board will meet this October at the 16th AMSAT Annual Meeting and Space Symposium in Vicksburg, Mississippi. At that time they will elect AMSAT Officers.

The LA2QAA Phased Array
A 70cm Electronically Switched Beam Antenna

John A. Hackett, LA2QAA (*la2qaa@amsat.org*)

Question: *How can you have a 19dB of recieve gain on a LEO satellite if you're not allowed to have large arrays?*

Answer: *You can use the LA2QAA 70cm phased array!*

This antenna is designed for the experienced satellite operator who needs a beam antenna for LEO DX on the FO analog or PACSAT digital satellites. Specifically, for those operators who for various reasons are unable to use large Yagi arrays.

It is a scaled-down version of my 15m phased array from a 1989 edition of *Amateur Radio* magazine. That design was based on an 80 meter phased vertical array by W1HKK in 1975 using quarter wavelength ground plane antennas.

The 70cm phased array uses 4-phased three-quarter length J-Poles matched with shortened quarter wave stubs. The antennas are in a diamond configuration and are phased thus:

The leading antenna is at 0 degrees, the two sides at –90 degrees and the rear aerial at -180 degrees.

The antennas are spaced a quarter wavelength from each other.

Each antenna is mounted on a short rod, each rod being attached to a baseplate, the base plate is attached to an adjustable microphone stand so the array can be tilted.

The array is switched electronically from the shack in one of four directions. It takes milliseconds to *turn the beam* (as opposed to the usual 60 seconds + with a rotator).

Those who wish to play with digital electronics can make up a system where the WiSP tracking program can automatically turn the beam.

Wilkinson type power dividers ensure correct phasing throughout the system.

The specifications are as follows:

- Forward gain: 9dB (see note).
- Front to back ratio: 25dB
- Front to side ratio (at 90 degrees): 12 dB
- Front to side ratio (at 135 degrees): 18 dB
- Vertical radiation angle: 19 degrees
- Half power beamwidth. (horizontal): 90 degrees
- Half power beamwidth. (vertical): Horizon to 60 degrees

Notes

In conjunction with a good preamp this receive system has a gain of 19 dB compared to a dipole *without* a preamp.

The antenna is small, inconspicuous and can be carried in a suitcase! It only takes a few minutes to erect or take down the complete system with the largest *item* being the microphone stand.

The low vertical radiation angle ensures a potent signal from near-horizon DX.

(See "Observations" in *OSCAR News*, regarding circular polarization vis-a-vis linear polarization with LEO's on near-horizon passes).

LEO's spend the majority of their time under elevations of 50 degrees.

The accompanying figures are self explanatory but a few notes may be in order.

The Control Box

The control box is a small plastic case with a 4 x 3 pole wafer switch and knob on top. The top also has 4 LED's in a diamond configuration showing which is the current direction selected. There is a phono socket on the rear for the +12v and a 3 pin connector on the side for the control line to the switchbox at the antenna. If desired, the control box may also contain a switch, LED and socket for remotely controlling a suitable preamp. The use of a sequencer is recommended if you have a costly GaAsFET at the *sharp end* of your cable. (A suitable design may be found on page 32-36 in the microwave section of the *1988 ARRL Handbook*. Remember that long runs of cable = voltage drop.)

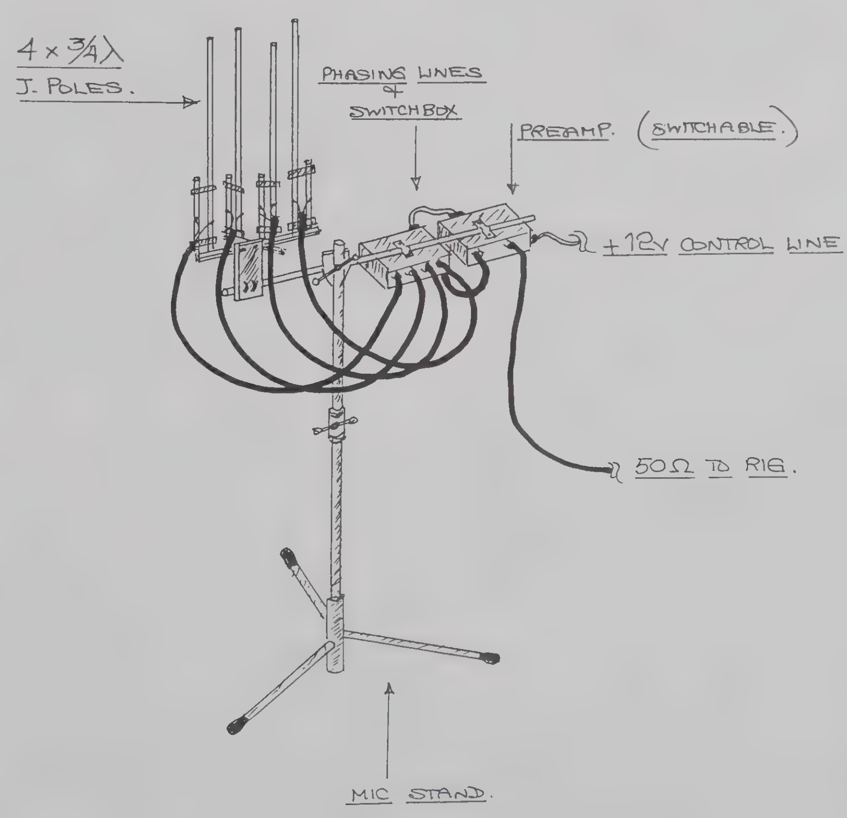


Figure 1. The LA2QAA phased array.

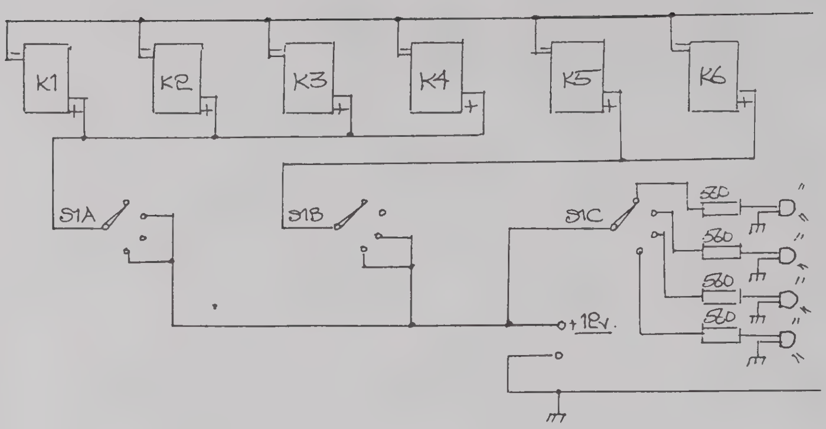


Figure 2. Array switching.

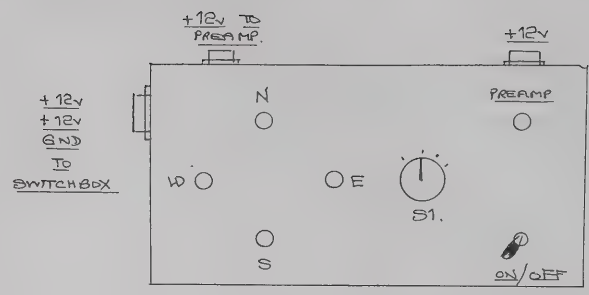


Figure 3. Suggested control box layout.

The Radiators

Each radiator is made from a 560mm x 10mm length of aluminum tube. Each matching stub is made from a 180mm x 10mm length of aluminum tube. The tubes are spaced 22mm center to center with aluminum shorting bars at the bottom and Plexiglas spacers near the top of the matching stub to hold the assembly rigid. The shorting bar and spacers are 42mm x 15mm x 5mm.

The Booms

The booms I constructed were made from aluminum with the dimensions of 130mm x 17mm x 8mm. However, you can use whatever dimension will give a rigid boom.

Attaching the Elements

First make up the four radiators and stubs using the shorting bars, spacer and 4mm nuts and bolts. The elements are attached to the booms using 40mm x 5mm bolts and nuts. Fasten a 40mm nut and bolt through the boom (see Figure 1). Push a 25mm length of *house wiring* plastic covering into the base of one of the tubes (it should slide in easily). Now *screw* the bolt that is already fastened to the boom into the base of the tube. The plastic sheath ensures it's a tight fit. You now have one element attached to a boom. Do the same with the other three elements.

Baseplate

The baseplate is made from a piece of aluminum 250mm x 75mm x 4mm. Bend the baseplate at 90 degrees 75mm from one end so that you have an elongated "L". (This is so that the array can be mounted to the end of a microphone stand for *tilting* it a few degrees from the horizontal). Mark out and bore 4mm holes in the end of the baseplate as per Figure 1. Bore a 10mm hole...(or whatever size the *screw thread* is)...at the other end of the baseplate.

Mount the booms to the baseplate. You should now have 4 J-Poles mounted on the baseplate spaced a quarter wavelength apart...(free space quarter wavelength at 435.850 = 172mm).

Bits 'N Pieces

The switchbox and preamp box are aluminum lunch boxes. I used waterproof BNC connectors (because they're small). The phasing lines are RG-58 and RG-59 respectively. Nuts and bolts are all stainless steel but you can use whatever you have in the junk box. The microphone stand fell off the back of a passing lorry! However, you can use whatever is convenient for the stand. (I also attach it to the front door with 6-inch nails - if you have an understanding XYL).

The Switchbox

The switchbox contains six relays and the associated 50 and 70 ohm coaxial phasing lines as well as the power dividers (see Figure 2). I built my switchbox using an aluminum lunchbox. The switch box is fastened immediately below the baseplate under the array. BNC connectors are used for the 4 equal length 50 ohm lines between the switchbox and array (see Figure 3). A 3 pin power socket is mounted under the switchbox. The PC board containing the relays, power dividers and phasing harness measures 140 x 95mm. I considered using etched lines and coaxial relays but the cost prohibits easy reproduction. Therefore I've used small relays culled from old telephone modems...(PCB mount)...and short lengths of 70 and 50 ohm coax for the phasing lines. At 435.850 MHz an electrical quarter wavelength is only 113mm. Some may frown at the relays used but remember this is predominantly a *RECEIVE* system and is designed for relatively low powered transmitters. How low is low? (Check your relays using Ohm's law.) Mine can operate safely with a transmitter output of 10w. Also remember to take account of the loss in the feedline so the 10w at the transmitter is less at the antenna...unless you're operating indoors.

If one is affluent enough, of course, coaxial relays can be used...permitting the use of higher power. (Though if you're sensible, you wouldn't use this antenna on AO-10.)

The antenna can be switched in one of four compass directions. (see Figure 4).

In switch position 1 the phasing is as follows:

- ANT 1 is phased by lines of 50/70 and 70 ohm -minus 90 degrees.
- ANT 2 is phased by lines of 50/70/50/70 ohm -minus 180 degrees.
- ANT 3 is phased by lines of 70/70 ohm - minus 0 degrees.
- ANT 4 is phased by lines of 70/50/70 ohm - minus 90 degrees.
- The antenna beams *EAST* with the switch in this position.

In switch position 2 the phasing is as follows:

- ANT 1 is phased by lines of 70/70 ohm - zero degrees.

- ANT 2 is phased by lines of 50/70/70 ohm - minus 90 degrees.
- ANT 3 is phased by lines of 70/50/70 ohm - minus 90 degrees.
- ANT 4 is phased by lines of 50/70/50/70 ohm -minus 180 degrees.
- The antenna beams *SOUTH* with the switch in this position.

In switch position 3 the phasing is as follows:

- ANT 1 is phased by lines of 50/70/70 ohm - minus 90 degrees.
- ANT 2 is phased by lines of 70/70 ohm - zero degrees.
- ANT 3 is phase by lines of 50/70/50/70 ohm - minus 180 degrees.
- ANT 4 is phased by lines of 70/50/70 ohm - minus 90 degrees.
- The antenna beams *WEST* with the switch in this position.

In switch position 4 the phasing is as follows:

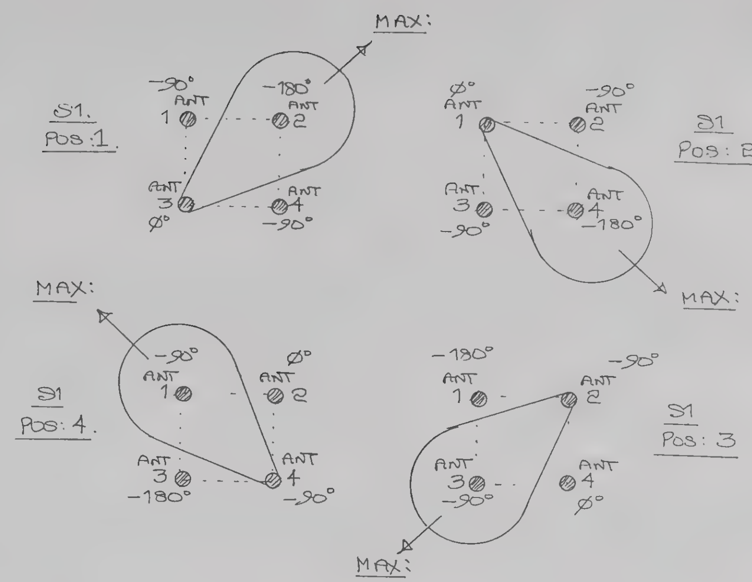


Figure 4. Horizontal radiation lobes/phasing.

- ANT 1 is phased by lines of 50/70/50/70 ohm -minus 180 degrees.
- ANT 2 is phased by lines of 50/70/70 ohm - minus 90 degrees.
- ANT 3 is phased by lines of 70/50/70 ohm - minus 90 degrees.
- ANT 4 is phase by lines of 70/70 ohm - zero degrees.
- The antenna beams *NORTH* with the switch in this position.

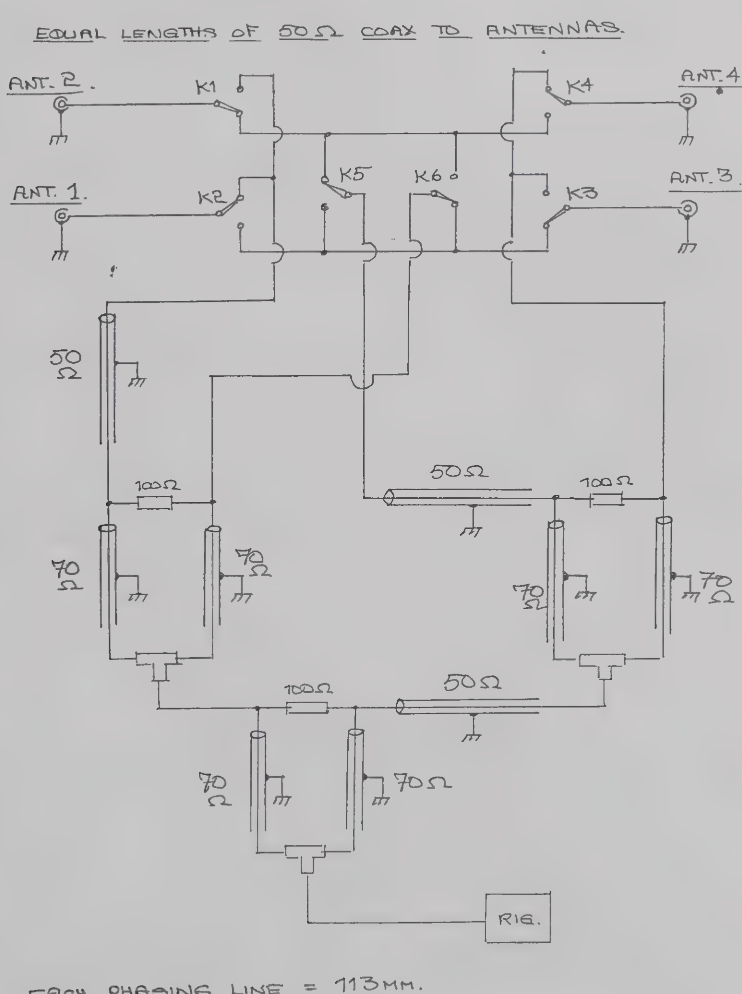


Figure 5. Phasing lines.

As can be seen from Figures 5 and 6. the antenna can be electrically *rotated*. Each phasing line is an *electrical* quarter-wave length. The combination of 50 and 70 ohm lines ensures correct impedance transformation throughout the system. The power dividers dissipate any out-of-phase energy returning along the line. (Use resistors with a dissipation according to the forward power if you intend to use this antenna for transmitting, though primarily it is designed to be a 70cm receive antenna. The *resistor* should be a *non-inductive* 100 ohm type. (I used 6 x 150 ohm in a series-parallel configuration (giving 100 ohm) simply because they were available in my junk box.

As previously mentioned, this antenna lends itself well to computer steering for PACSAT use. Anyone who fancies a bit of digital electronics and just happens to be a programmer can soon work out a simple interface so that it can be automated using a PC program. (Don't forget to send me a copy!).

Preamp

In my system, I have a homebrew preamp using a cheap BFR 90 bipolar transistor (see Figures 7 and 8). The preamp uses the *box in a box* technique to protect it from the weather. The main enclosure is an aluminum lunch box. Inside the lunchbox the preamp is mounted in an enclosure made from PCB material (Figure 9 shows actual

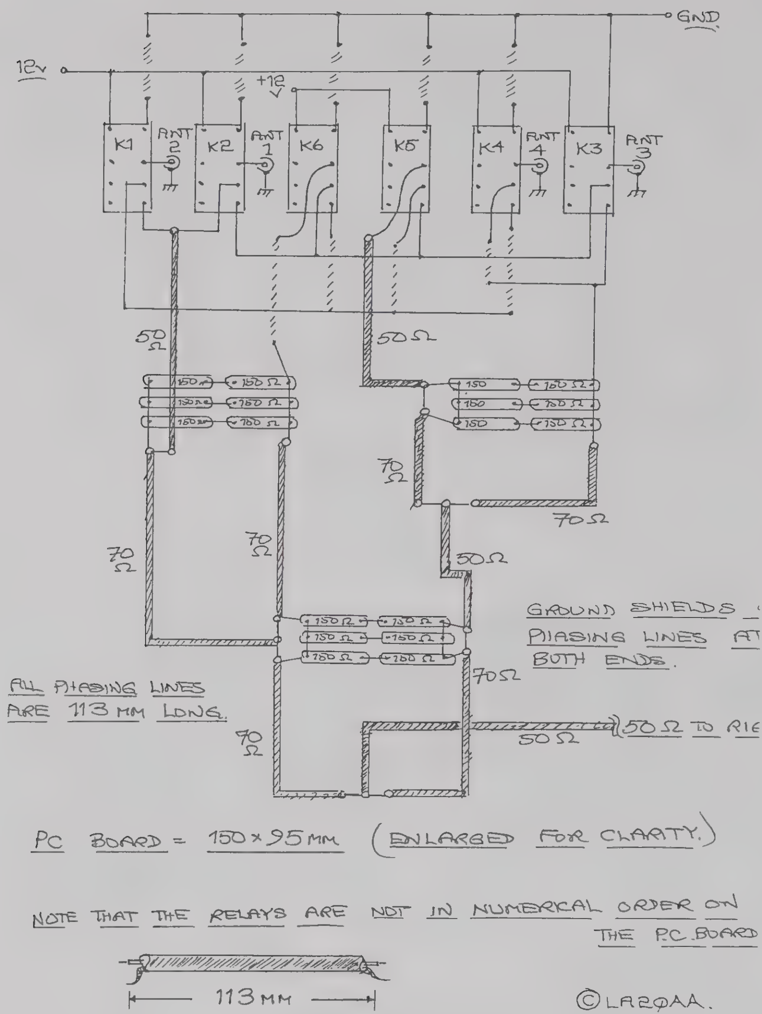


Figure 6. PC board layout.

size). This preamp doesn't have the *lowest noise figure in the world* but is adequate for the job. By replacing the cheap BFR transistor with a low noise NE64535 transistor a noise figure of under 1dB with 14dB gain can be achieved. It's probably not worth investing in an ultra low noise GaAsFET for this system. Many people have carried out experiments in search of the ultimate design. Most agree that the input matching circuit is of prime importance regarding low noise figures. The copper strap...(L1)...in the design shown is probably the best compromise for good matching/low noise figure. Be aware when tuning the preamp that low noise figure and maximum gain do not necessarily coincide.

Measurements

Simple measurements of this array can be performed using a suitable calibrated field strength meter.

Cost

The *total* cost of this antenna should be less than five dollars! If you have a good junk box the 19dB gain works out to about 3.8dB per dollar.

Observations from Norway

I told you *Observations* was topical didn't I? We have all heard and digested the bad news regarding the Phase 3D launch. A *worst case* situation means we have to raise *10 million US dollars*...that's a ten and 6 noughts folks! Lets hope it never comes to that. I haven't received one single offer as *coordinator* for the *Knickers for Phase 3D Fund* (looks like we need a few more *drawers* than first envisaged). Anyone got a better idea for getting Phase 3D launched?

Now is the sort of time when it is *easy* to criticize and *hard* to do something constructive. (You always find out who your friends are when the going gets tough.) *It is more important than ever now to support AMSAT*. People do of course! And members have the *right* to comment and complain, but do lets try to keep the criticism *constructive* eh?. "I told you so!" serves no useful purpose. Sensible suggestions re: what we do next, how, and etc. *will* serve a useful purpose. Think about it.

I would respectfully remind all readers that there are lots of folks doing lots *free* for the benefit of your pleasure (why else would you operate satellites). It is *unfair* to blame them for the unfortunate situation that has arisen regarding Phase 3D. Please *think* before speaking. If anyone is to *blame* it is most certainly not AMSAT. *Don't cut off your arms to spite your face!*.

Field Day

I cheated. I ran a cable from the shack to the waste ground at the rear of the house where the antennas are situated. Armed with

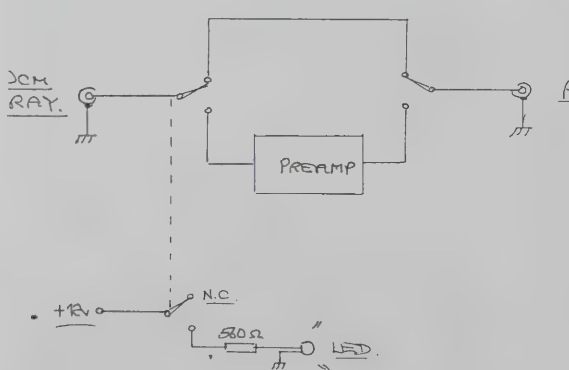


Figure 7. Optional switchable preamp.

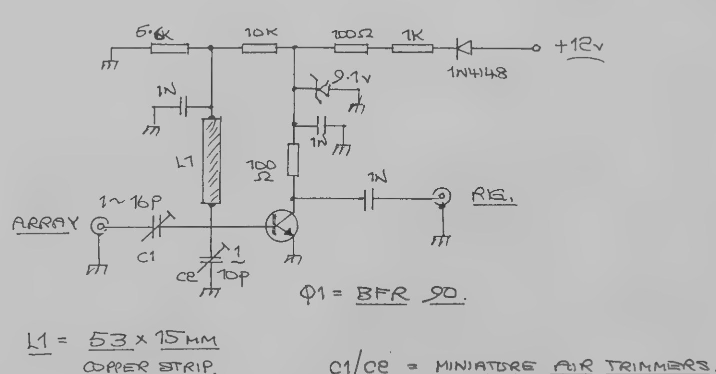


Figure 8. Preamp schematic.

a printout of the pass I headed for the *wild outdoors*.

The neighbors thought I was off my rocker as I sat under my beams with the rigs in the long grass. I assume the rest of you were out humping battery packs and generators while the XYL was picking daisies? I did work Dave Houlden, G1OCN in the *early hours* of Sunday morning. (Guess whether I remembered Dave's name or not), yes, you're right, or not. Plenty of activity from the European stations. However, too much activity for me to call CQ on top of the other stations calling CQ on top of the other stations calling CQ so I waited until FO-20 was over Greenland and the main part of Europe was out of the range circle before chipping in with my two penny's worth. Called CQ and got a reply from Sam K8EYZ in Michigan running a genuine outdoor Field Day satellite station. Well done all at *Sam's Place*!

AO-10

G. R. Ashdown, VK4ABW came booming in this morning. Those complaining of *no DX* please note the distance between Frei Island and Australia. Due to my usual five watt limit I didn't work the VK but a couple of others did. I have a 25 watt amplifier for 70cm but due to my bone idle nature it was too much trouble to hook it up to the power supply. The three hour window window into VK ranged from one to 19 degrees in elevation and then 25 and back to 19 degrees elevation. Again, you can't get it more perfect than that (especially

when you have a fixed elevation of 25 degrees). A pity I'm so idle because VK/LA contacts via satellite don't occur every day. This is most probably due to the fact that I sit on FO-20 day and night and the "other three" Norwegian operators are RS men. The last time I was on AO-10 (2 years ago) I managed to work *all the way* into Finland one morning and spent the next three hours calling CQ with no reply. At least on FO-20 if I get no reply (seldom) the CQ's only last about ten minutes. In the course of the day I may decide to throw caution to the wind and connect the amplifier to the power supply for tomorrow's AO-10 pass. But then again, that would entail soldering a plug on the cable (phew!) which is at least two minutes of *work*. I think I'll just wait for Phase 3D. Why do today what can be put off until tomorrow. For those wondering why I didn't

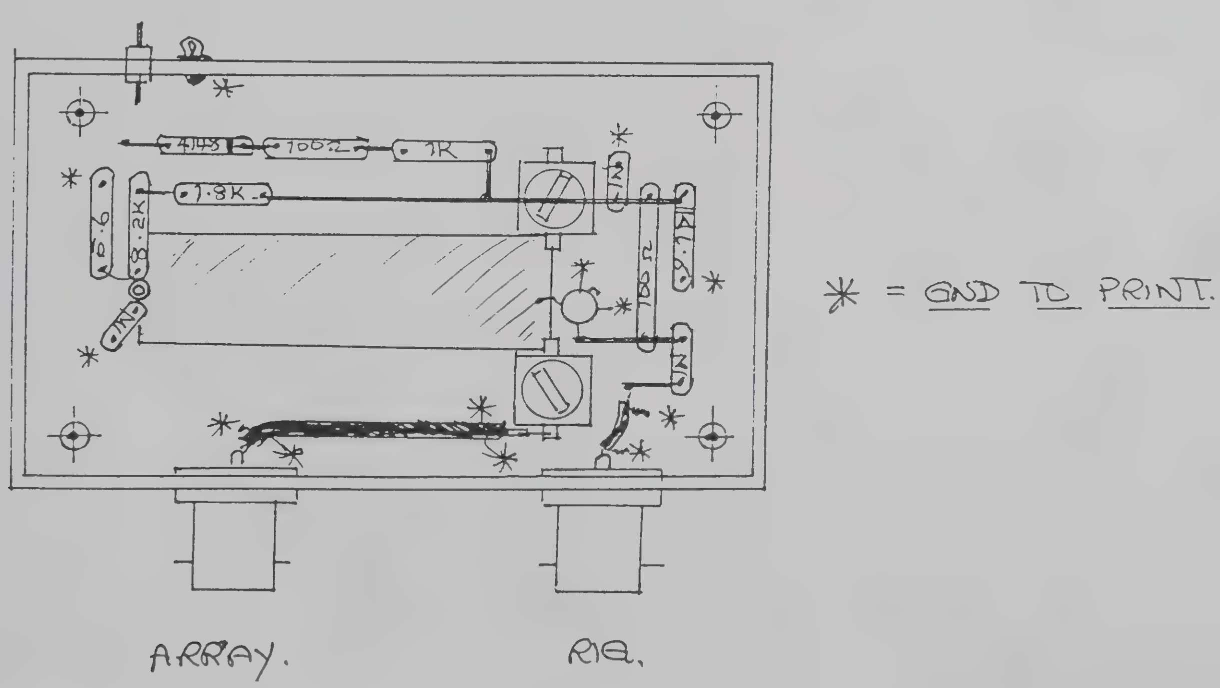


Figure 9. Preamp housing (actual size).

go overboard on hearing the VK, I used to run the *expat* RSARS net from Gossen Island to Brisbane in the early 1980's so had my share of *pomming i*" with the *Roos* and *Wallys* (VK's and ZL's).

Continuous Wave vs. SSB

Regular readers may recall my earlier question in *Observations* on why there's so little CW on FO-20? Obviously, some of the VHF/UHF operators never bothered to learn Morse code. However some did, particularly the EME men. Being able to read CW is a great advantage, particularly when copying FO-29's beacon. In the last several weeks I've been pleased to work quite a few countries on FO-20 and FO-29 using CW, which allows me to rest the *dulcet* Manchester accent. This morning I was particularly pleased to work Frank Wiesenmeyer, K9CIS using CW on FO-20. Frank was calling CQ and getting no reply with the whole of Europe was in the range circle. I listened for a couple of minutes but there were only a few DL's calling CQ on SSB. I called Frank, he replied immediately and we had a nine minute CW QSO. Frank told me he'd read my comments on why no CW on FO-20. As a result he had in fact been looking out for me. (Frank was CW only). Near the end of the QSO when FO-20 was down at 5 degrees elevation, I switched to SSB to prove a point. Frank didn't hear me at all! I switched back to CW and we were able to carry on the conversation until the satellite dropped below my horizon. Frank was using just seven watts and I was using my usual five watts. Frank's QTH is in Decatur, Illinois. So I hope these paragraphs will serve to illustrate that CW is still a valid communications mode, even via satellites other than RS-12.

Up Before the Birds

Sunday morning, 0408 GMT: no, not a late night, an early morning! Call it dedicated satellite operating. I *threw* myself out of bed at this ungodly hour to check the propagation eastward since, for the last several months I've been operating FO-20 westward from my QTH on mid-day passes. Absolutely nothing heard from the beacon as the satellite came up over Japan and north Korea (just on the horizon). But by the time it was over Mongolia I could hear the beacon faintly. Good signals when it dropped down over India but no ground stations were operating until it began to rise again over Asiatic Russia. The first station I heard was Deiter Huebner, DH1RSR (ex DG1RSR) who was obviously on the same *mission* as myself this early on a Sunday morning. Either we're dedicated satellite operators or daft! I didn't ask Deiter what on Earth he was doing out of bed at this hour though he was probably wondering the same thing about me. (Maybe Deiter had also figured out that to beat the Sunday morning QRM you had to rise before the *swishers*.) We just had a friendly chat and like myself probably went back to bed afterwards (the egg n' bacon being put on hold for a few hours). Unlike the noon passes where the signals are usually weakest when the satellite is in *pole position* (over the north pole). On this early morning pass the signals were strongest while the satellite was actually in the polar region. However, the penguins didn't bother to answer my CQ's so I went back to bed!

Results

Regular punters will recall my asking for feedback in the last issue of this illustrious rag. Almost to a man the results were identical. I'd stated that the request for feedback was *unofficial* and merely to *test the water* so to speak. So what did Joe Bloggs reply? In all cases the people who answered commented thus:

- I only read the Observations column anyway!
- Most of the stuff is boring.
- Keeps it nice and friendly.
- How does AMSAT expect to get new members and etc.
- What family man can afford this outlay?
- I simply can't afford to...and etc.
- Schoolchildren are not going to read these *techy* things.
- Isn't it supposed to be *fun*?

I have decided that I will ignore the single complaint and follow the advice of the *many* who took the trouble to answer. *Observations* will carry on regardless, at least until someone contributes a few interesting constructional articles or other articles designed to make the newcomer curious enough to want to find out more and join us.

None of us is getting any younger and if we don't recruit, AMSAT will wither away with time. No potential newcomer can afford to go out and purchase the latest PC, FT736R and a pair of expensive rotators. Therefore it's extremely important to cater for the newcomer with the KISS principle. (Which is what OBSERVATIONS tries to do.) By all means while we should keep AMSAT at the cutting edge of technology, we musn't forget those that will eventually be required to take the helm. Nobody starts out as an expert. They must be given the opportunity to learn. It's DEDEEEZY for the *expert* to say I know all that (and move higher in frequency). But the newcomer *doesn't* know it. Who's going to teach him? The present *experts* will not live forever.

I have, in partnership with Allan Copland, GM1SXX produced a book entitled *The Beginner's Guide to Amateur Satellites*. The 96 page book covers everything you need to know to get started (as well as being a useful reference manual for the *expert*). All proceeds are donated to AMSAT. This is our way of trying to ensure the organization can recruit. (The book is available from Al via e-mail him at *gm1sxx@amsat.org*).

Since we're not getting too much publicity I thought I'd give it a *plug* in *Observations*. Remember, it's in our own interest to get as many people as possible interested in the organization. Without them we're going to fade into oblivion. Think about it? Do *you* know someone who may find communications via satellite interesting? Talk to them. Tell them *you do not need to be a millionaire*. It's by *word of mouth* that the message gets through. They will not read the technical blurb because it's boring!

To those that replied to my request, *thank you*!. It's nice to know that some of you are concerned enough about AMSAT's future to take the time to say what you think. The bottom line being that it should be a fun thing and available to *all*, not just the affluent. 73, John LA2QAA ■

Field Ops Update: Workshops, Hamfests, and Symposium Activities

Barry A. Baines, WD4ASW (*wd4asw@amsat.org*)

Summer is now over and as we approach the annual AMSAT Symposium, it is an appropriate time to acknowledge the important role that our volunteers have served in representing AMSAT as well as highlight several field organization activities that will take place at the AMSAT Symposium in Vicksburg, MS the weekend of October 16th.

Satellite Workshops

Another AMSAT/ARRL Workshop took place on Friday, August 14th in association with the ARRL Southwest Division Convention in San Diego, CA. This workshop was the second one of the year (the first was at the Orlando Hamcation back in February) and also the second consecutive year that a workshop was held in conjunction with the Southwest Division Convention. While the venue had changed from Riverside to San Diego, CA there was the same strong interest from newcomers and experienced operators who came to attend as there had been in 1997. Keith Baker, KB1SF and Larry Brown, NW7N were back to provide an extensive overview of satellite operations to the 29 attendees.

Keith and Larry took a slightly different tact than what we had tried in the past. Prior to commencing their presentations, they took the time to ask each workshop attendee to provide one or two specific expectations that they hoped would be covered by the workshop. During this ten-minute query, they listed each statement on an easel. During the course of the workshop, they would periodically review the list and check off an item if it had been covered. The beauty of this approach is that it allowed each registrant to feel that their particular questions/concerns were addressed as well as help to shape the framework for the workshop itself. This process broke the ice with the audience and allowed the presenters to gauge the audience's interest and technical level. In actuality, there were only one or two items requested that were not already documented in the materials and it was an easy matter to address those areas in conjunction with an existing presentation.

Following the presentations, the attendees were given a questionnaire to complete in order to help ARRL/AMSAT improve the quality of the satellite workshops. As a result of the approach taken by Keith and Larry to identify participant's expectations, they received very high marks in the areas of addressing the needs of participants and value of the workshop to the attendees. AMSAT volunteers may want to take this idea and apply it the next time they are giving an AMSAT presentation to a club, for example. Take a moment to query your audience and get an idea of what they want to hear prior to starting your formal program. For example if you plan to talk about the *Easy Sats*, you may learn that your audience is more interested in learning about station equipment as opposed to spending a lot of time on satellite tracking. Such information will help you to emphasize those areas

Satellite Orbital Elements

Ray Hoad, WA5QGD

Satellite	AO-10	AO-27	FO-20	FO-29	RS-12/13	RS-15	RS-16
Catalog Number	14129	22825	20480	24278	21089	23439	24744
Epoch Time	98207.89601272	98260.75554500	98260.14719706	98259.97406402	98260.21363538	98260.73171964	98260.15353323
Element Set	557	668	95	192	112	329	269
Inclination	26.8741	98.4959	99.0589	98.5229	82.9233	64.8192	97.2425
RA of Node	76.4134	328.5401	141.491	243.1763	299.7022	132.9924	162.4883
Eccentricity	0.5978687	0.0008902	0.0541163	0.0352275	0.0030549	0.0148899	0.0003702
Arg of Perigee	235.7019	345.6875	63.1586	82.0251	103.4311	43.536	251.3863
Mean Anomaly	52.4624	14.4052	302.3794	282.0707	257.0252	317.7202	108.6975
Mean Motion	2.05882825	14.27799243	12.83245383	13.52646978	13.74106102	11.27530988	15.38755879
Decay Rate	0.0000019	0.00000034	-0.00000057	-0.00000012	0.00000013	-0.00000039	0.00018188
Epoch Rev	11369	25936	40331	10287	38192	15352	8614
Satellite	UO-11	UO-14	AO-16	DO-17	WO-18	LO-19	UO-22
Catalog Number	14781	20437	20439	20440	20441	20442	21575
Epoch Time	98259.93954365	98260.21381192	98260.21422773	98260.22392717	98260.16308539	98260.16240323	98260.67635532
Element Set	98	386	177	180	188	191	885
Inclination	97.8883	98.4832	98.5078	98.5138	98.5129	98.5177	98.241
RA of Node	229.5009	336.0655	340.1665	341.4037	341.1796	342.1391	308.4141
Eccentricity	0.0011881	0.0010782	0.0011008	0.0011109	0.0011638	0.0012261	0.0007853
Arg of Perigee	350.52	305.9144	308.0049	305.843	307.0452	306.5647	328.2233
Mean Anomaly	9.5778	54.1033	52.0131	54.172	52.9665	53.4406	31.8478
Mean Motion	14.69883058	14.30047229	14.30088913	14.30236341	14.30197339	14.30319605	14.37178307
Decay Rate	0.00000764	0.00000135	0.00000088	0.00000117	0.00000123	0.00000114	0.00000117
Epoch Rev	77834	45153	45155	45159	45158	45161	37619
Satellite	KO-23	KO-25	IO-26	TECHSAT	TMSAT-1	MIR	Phase 3D (Est)
Catalog Number	22077	22828	22826	25397	25395	16609	999934
Epoch Time	98260.14637011	98260.19093800	98260.19780237	98260.19543454	98260.75459971	98260.98216354	96260.25520000
Element Set	779	654	667	161	37	793	3
Inclination	66.0821	98.4939	98.499	98.7911	98.7863	51.6596	60.0203
RA of Node	268.4623	328.4815	328.3777	330.0383	330.6013	295.8438	342.7876
Eccentricity	0.0014176	0.0010238	0.0009599	0.0002102	0.0004403	0.0007874	0.6752895
Arg of Perigee	285.5168	329.0584	346.6573	114.299	129.4146	101.7745	180.1221
Mean Anomaly	74.4281	30.9987	13.4336	245.8407	230.7422	258.4165	179.5059
Mean Motion	Motion	12.86312023	14.28268058	14.27913722	14.22186812	14.22267933	1.51063698
Decay Rate	-0.00000037	0.00000105	0.00000088	-0.00000045	-0.00000045	0.00040121	0.0002
Epoch Rev	28652	22744	25930	983	989	71860	2

that you were ready to discuss but perhaps did not plan to emphasize. Many thanks to Larry and Keith for their outstanding efforts in giving a very successful workshop and for sharing this suggestion.

While the workshop was on Friday, the convention itself was on Saturday and Sunday. Booth activities were led by Duane Naugle, KO6BT with assistance by his XYL, Jean, KA6QHT. Southern California appears to be a relatively untapped area for AMSAT interest, as evidenced by the fact that while the hamfest drew around 2,400 attendees (which is relatively small compared to hamfests such as Dayton, Miami, Orlando, Rochester, and etc.), total donations were around $2,300.00! On a 'per attendee' basis, AMSAT did exceedingly well. Duane and his team did a great job of 'talking up' interest in satellites, with the booth running out of a number of items, such as tracking software. Thanks to Paul Williamson, KB5MU, the first two images from Tech-Sat TO-31 were posted on the booth. Overall, AMSAT enjoyed a great success at San Diego.

Other Hamfests

Many volunteers help out with representing AMSAT at hamfests of various sizes in their local areas. In fact, there have been about 40 hamfests held from January through September of this year that Martha has coordinated materials with a volunteer to have available at these shows. And while it is not possible to highlight every show that has an AMSAT presence, we need to recognize the contributions that have been made to date. You will find a list of each hamfest held this year that Martha has sent AMSAT materials to 'show the flag' with the date, location, and team leader associated with each event. Of course, there were a number of volunteers who helped out at many of these hamfests and lack of space prevents us from listing each team member. Many thanks to volunteers who have helped represent AMSAT at these shows.

Field Operations at the Vicksburg Symposium

Two different activities are planned during the AMSAT Symposium, October 16-18 in Vicksburg. On Friday evening, October 16, a 'Beginner's Forum' will be held from 1830-2030 hrs. This is an excellent opportunity for newcomers to gain an understanding of amateur satellite communications. This is an 'open' activity with no required registration. The forum will be led by Keith Baker, KB1SF and Steve Bible, N7HPR. Both individuals are veteran satellite workshop presenters, with Keith having done workshops since 1995 while Steve assisted with the AMSAT/ARRL Satellite Workshop in Orlando earlier this year. Both are authors of AMSAT publications, with Keith writing the *How to Use Amateur Satellites* while Steve has written the WISP installation and configuration instructions in the *AMSAT Digital Satellite Guide* that was released earlier this year at Dayton. Keith will discuss the 'Easy Sats' while Steve will provide an overview of digital satellites.

The Symposium Committee has done an excellent job of publicizing the Beginner's Forum, sending notices to over 250 clubs in Mississippi, Alabama, and Arkansas in order to encourage newcomers to attend the Forum. Individuals who are attending the Symposium are also encouraged to attend the Beginner's Forum itself. In particular, Area Coordinators and others interested in making their own presentations in the local communities may want to attend in order to get ideas that they can use later in their presentations. In addition, being able to attend such a gathering will help veteran users understand the kinds of topics that beginners want to learn. It should also provide to veteran users some insight into what will make a successful exchange of information to those people not already familiar with satellite communications.

On Sunday morning, the traditional Area Coordinators Breakfast will be held from 0700-0900. This is a wonderful opportunity for Area Coordinators and others interested in representing AMSAT in their home communities to exchange ideas, share success stories, and help boost each other's motivation for boosting AMSAT in their respective areas. Anyone interested in learning about being designated as an A/C is certainly invited to attend as well.

We continue to look for volunteers to help out. While volunteers have represented AMSAT at about 40 hamfests so far this year, there have been a number of large hamfests that AMSAT was not present because of a lack of an area coordinator to handle the opportunity. This situation has occurred recently with the Virginia Beach Hamfest as well as the Rochester Hamfest this past May. So, if you are attending the Symposium and are thinking of learning more about the Field Organization and how our volunteers serve as *Ambassadors of AMSAT*, please plan to attend the Breakfast. Check out the Symposium Agenda when receiving the Symposium registration packet for specific location. The Area Coordinator's breakfast will be lead by George Caswell, W1ME. George is one of AMSAT's veteran A/C's who has been very successful in building interest in AMSAT in Northern New England.

Please feel free to contact me at *wd4asw@amsat.org* if you have any questions about Field Operations or are interested in representing AMSAT as an Area Coordinator. ■

Thanks to the following Team Leaders for volunteering to take charge of AMSAT's presence at the hamfests and shows:

- 1/10/98, Westfest Thunderbird AR, James Weisenberger, AA7KC
- 1/17/98, Digital Symposium, Gerd Schrick, WB8IFM
- 1/18/98, Richmond, VA Frostfest, Howard Ziserman, WA3GOV
- 1/24/98, Winterfest 98, Mike Koenig, N0PFF
- 2/7/98, Jackson, MS Hamfest, Eddie Pettis, N5JGK
- 2/7/98, Webfooters Swapfest, Jerry Ervine, KC5YRE
- 2/8/98, Miami Hamboree, Bob Walker, N4CU
- 2/13/98, Norfolk, NE, Chad Phillips, KG0MW
- 2/13/98, Vienna Frostfest, Howard Ziserman, W3GOV
- 2/14/98, Orlando Hamcation, David Jordan, AA4KN
- 2/21/98, Cincinnati, OH, Keith Baker, KB1SF
- 3/7/98, Charlotte, NC, Russ Platt, WJ9F
- 3/7/98, Parispanny, NJ, Dee Interdonato, NB2F
- 3/14/98, Springfest, Larry Brown, NW7N
- 3/28/98, Parker, CO Hamfest, Keith Pugh, W5IU
- 3/14/98 , AARA Lafayette, LA, Roger Ley, WA9PZL
- 4/4/98, AES Superfest, Richard Sell, N9MYK
- 4/4/98, LARC Fest, John Gubbins, N0VSE
- 4/5/98, ARRL NC State Convention Carl Starnes, W4EAT
- 4/10/98, Tupelo Hamfest, Eddie Pettis, N5JGK
- 4/25/98, Old Natchez Hamfest, Eddie Pettis, N5JGK
- 4/25/98, Semara, James French, KD4DLA
- 5/1/98, Baton Rouge, LA, Ken Shutt, K5GUU
- 5/16/98, Dayton Hamvention, Barry Baines, WD4ASW
- 6/7/98, Manassas Hamfest, Howard Ziserman, WA3GOV
- 6/6/98, Bergen, NJ ARA Hamfest, Dee Interdonato, NB2F
- 6/13/98, HAMCOM, Ft. Worth, TX, Keith Pugh, W5IU
- 6/14/98,Knoxville, TN Hamfest, Gould Smith, WA4SXM
- 6/20/98, Frederick, MD ARC Hamfest, Howard Ziserman, WA3GOV
- 7/12/98, Sussex, NJ Hamfest, Dee Interdonato, NB2F
- 7/24/98, Ft Tuthill Hamfest, Larry Brown, NW7N
- 8/1/98, Jacksonville, FL Hamfest, Barry Baines, WD4ASW
- 8/8/98, ARK-LA-TEX Hamfest, Roger Ley, WA9PZL
- 8/15/98, Huntsville, AL Hamfest, Gene Marcus, W3PM
- 8/15/98, Rome NY Hamfest, Randy Baker, WA2EXJ
- 8/15/98, Charlotte VT Hamfest, Tom Whitney, N1GZZ
- 8/15/98, ARRL SW Division Convention, Duane Naugle, KO6BT
- 8/29/98, Boxboro MA Convention, Ernie MacLauchlan, K1ELA
- 9/12/98, Melbourne, FL Hamfest, David Jordan, AA4KN
- 9/12/98, Greenville, MS Hamfest, Eddie Pettis, N5JGK
- 9/26/98, Huron Hamfest, SD, Chad Phillips, KG0MW

Other Materials Sent to Support Hamfests in September:

- Ed Cole, AL7EB, Alaska

Leonied Labutin, UA3CR SK Remembered

Leonied Labutin, UA3CR died of a heart attack on September 10, 1998 while at his summer residence near Moscow. The funeral was held in Moscow on September 12, 1998.

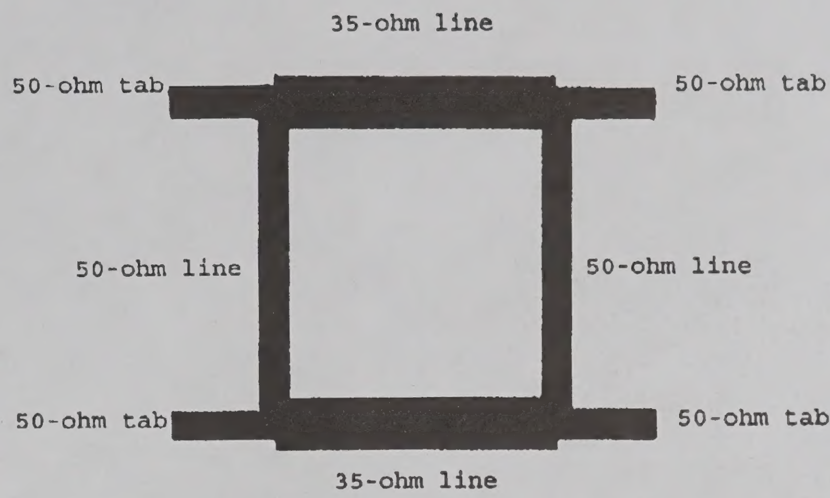
Back in the late 1970's Leo wrote a series of articles in the Soviet magazine *RADIO* concerning experiments using a linear transponder from the roof of a Moscow apartment. Reading between the lines it was clear that a group in Russia was working on an amateur satellite project. Over the next decade Martin Davidoff, K2UBC sent him copies of many of his articles and reports via Box 88 and watched the birth of the RS program. Leo was a very well known and respected person in the Russian amateur satellite and space scene. He was at the South Pole after the launches of RS5 - RS8 for testing store and forward techniques from remote locations. He also assisted the North Pole Bering Bridge Transpolar Ski Trek Expedition from USSR to Canada in 1989 including communication via Amateur Radio satellites. During this event, Tom Clark, W3IWI recalled working him on one of the RS satellites from Leo's QTH in the Arctic Ocean. This was a special joy for W3IWI as it gave him a very rare LEO satellite contact from Asia for WAC. W3IWI also remembers Leo personally delivering him the QSL card for the contact when they met later in Ottawa, Canada to plan cooperative activities for a trans-polar ski treks.

Leo was directly involved in various RS satellite projects and helped bring ham radio to the *Mir* space station. He also operated a mailbox system and digipeater in Moscow with a regular Gateway to UO-22. He was one of the first groundstations and gateway for the digital communications experiment on UO-11. Peter Güzlow, DB2OS recalls working together with Leo on AO-21/RS-14 which was the first Russian/German amateur satellite project. Leo also provided great assistance to the AMSAT Phase 3D project by coordinating the donation of the fuel tanks from a Russian space company.

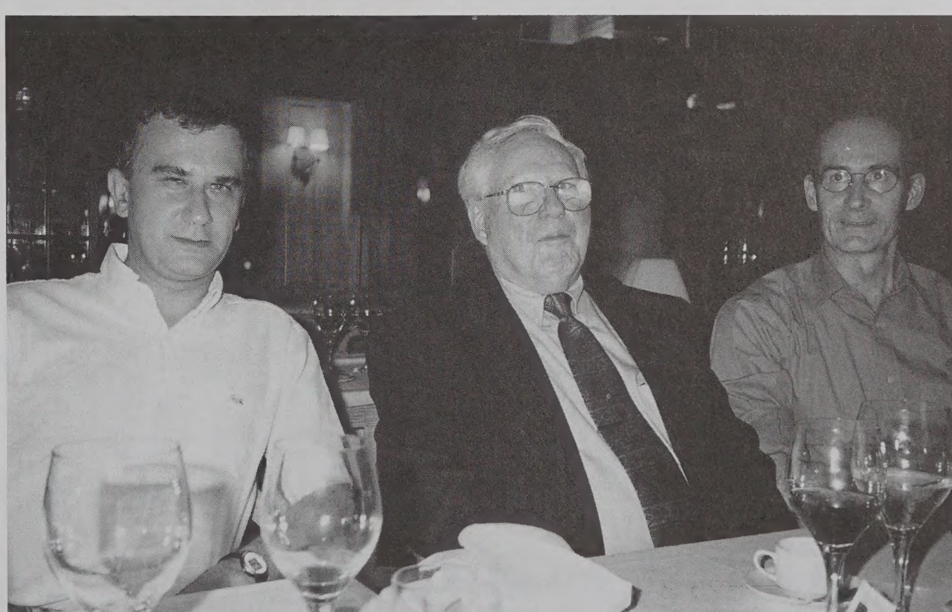
In early November 1988, K2UBC received a call from Martha saying that Leo had obtained permission to attend the AMSAT Annual Space Symposium that was being held in Atlanta, GA. K2UBC met Leo when his Aeroflot flight landed at Dulles Airport and even though it was the first time he met Leo, it was like seeing an old friend. They spent a day and a half K2UBC's QTH and then flew to Atlanta for the conference where the first *Mir* – U.S. Amateur Radio QSO was completed from the hotel parking lot. Meanwhile, Leo had made the first QSO with *Mir* from his home a few days earlier and K2UBC recalls that the midnight phone call from Leo's Atlanta hotel room to Star City the night before the *Mir*/U.S. QSO was more exciting than the contact itself. Also while in Atlanta, Leo amazed participants by passing all elements the U.S. Extra Class license in one sitting, despite some problems with English. As a result, Leo obtained the U.S. call sign AB4LZ that was a first for a Soviet citizen.

K2UBC also remembers having lunch with UA3CR and Geof Perry at the 1990 AMSAT-UK meeting. At the time, Perry was teaching high school physics while he and his students, developed innovative techniques to monitor the secret Soviet space program. As a result, they became the leading western source for information on the Soviet space program. This was the first time Leo and Perry had met and old speculations were traded and confirmed at a mind-boggling rate.

Tom Clark, W3IWI remembers visiting Leo and his family in Moscow in 1991. Leo made a special trip home from the Irkutsk area of Siberia to meet with Clark. During his visit, UA3CR's *Adventurers Club* was sponsoring a trans-Soviet wheelchair race and Leo and his son gave Clark a tour of the club facility. This site, which they hoped would soon rival the U.S. National Geographic Society, also housed the Moscow HF packet radio gateway that was the first reliable source of e-mail to and from the Soviet Union. During this visit W3IWI also delivered a number of hard-to-get ICs that were needed desperately to get some VHF packet radio nodes running in Moscow. After a tour of the club and some off-the-beaten-path places in the Arbat, they returned for the very Russian celebration between friends with bread, sausage, cucumbers, cheese, Vodka, and Ukrainian wine.



Andy MacAllister, W5ACM clarified a few details of the board layout from the article "A Simple Dish for Mode L" (May/June issue of *The AMSAT Journal*). In the hybrid ring, the vertical lands that are shown to be 0.260 inches wide. All dimensions should be 0.167 inches wide. The unlabeled horizontal lands are 35 ohm strip lines and should be 0.260 inches wide. All dimensions assume the use of 1/16 inch- thick, double-sided teflon circuit board material. The dielectric coefficient of the teflon/fiberglass board is much lower than standard fiberglass board and allows for a larger ciruit layout that is easier to work. Teflon board material also has more consistent characterisitics from one batch to another, thus it is a better choice at microwave frequencies. Don't forget to mask the back side of the board (per the article) before etching. W5ACM's coffee-can feed has been in active use since AO-10, and due to a great paint job, may make it another 15 years.



On a recent pleasure trip to Europe, AMSAT-NA President, Bill Tynan, W3XO, had the opportunity to have dinner with AMSAT-France members Ghilislain Ruy, F1HDD/ON1RG (l) and Benard Pidoux, F6BVP (r). F1HDD is in charge of the DSP experiment for the AMSAT-France Maelle microsatellite project and has also contributed to several other AMSAT software projects. It was AMSAT-France which produced the flight reflectors for the Phase 3D short backfire antennas.